

# Natural Hazard Pre-Disaster Mitigation Plan



## Utah's Wasatch Front Davis, Morgan, Salt Lake, Tooele, and Weber Counties



Wasatch Front Regional Council  
December 2003

# Natural Hazard Pre-Disaster Mitigation Plan

Prepared by LaNiece Dustman with assistance from Jim Boes in the offices of the Wasatch Front Regional Council. Guidance provided by Ryan Pietramali from the Utah Division of Emergency Services and Homeland Security.

December 2003

## **Executive Summary**

### **Plan Mission**

The mission of the Wasatch Front Regional Council (WFRC) Pre-Disaster Mitigation Plan (PDM) is to substantially and permanently reduce the region's vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer more sustainable community.

### **Plan Organization**

The WFRC plan was developed and organized within the rules and regulations established under 44 CFR 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on communities within WFRC, as well as a hazard identification study and a vulnerability analysis of eight hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This is intended to improve the communities within the WFRC planning district ability to handle disasters, and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

### **Plan Financing**

The WFRC PDM Plan has been financed and developed under the PDM Program provided by the Federal Emergency Management Agency (FEMA) and the Department of Public Safety Division of Emergency Services and Homeland Security (DESHS). The WFRC aided in funding and provided in-kind assistance to local governments.

### **Plan Participation**

The WFRC PDM Plan has been completed as a result of a collaborative effort between The WFRC, DESHS, City and County Emergency Managers, Fire Departments, Sheriff Departments, Public Works Departments, Planning Commissions, Assessor's Office, City and County GIS Departments, Elected Officials, Public Employees, and Citizens of the cities and towns within Davis, Morgan, Salt Lake, Tooele, and Weber Counties. Interviews were conducted with stakeholders from the communities, and a workshop was conducted during the plan development. Additionally, through public hearings, workshops, and draft plan displays; ample opportunity was provided for public participation. Any comments, questions, and discussions resulting from these activities were given strong consideration in the development of this plan.

### **Hazards Identified**

It was suggested by the DESHS that at a minimum, the PDM plan address the hazards of: earthquake, flood, landslide, problem soils, wildfire, dam failure, severe weather, and drought. However, there are other hazards that were identified which are not in the minimum criteria established by DESHS that were added to the discussion.

The hazard identification study recognized the following hazards as being the most prevalent and posing the most potential risk to the counties and towns within the WFRC five county planning districts.

- Earthquake
- Flood
- Drought
- Landslide
- Wildfire
- Dam Failure
- Severe Weather
- Infestation

**Plan Goals**

In an effort to ensure that the mission of the WFRC PDM Plan is met, the participants in the development of this plan defined and established a list of goals, which are directly relevant to meeting the mission of the plan.

The following is a list of the goals identified by the participants of this plan:

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains
- Minimize the impacts of flooding
- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire

## Acknowledgements

The Wasatch Front Regional Council would like to extend their appreciation to the following agencies, which assisted in the development of this plan.

- Utah Division of Emergency Services and Homeland Security
- Federal Emergency Management Agency
- National Weather Service
- National Climate Data Center
- Utah Army Corps of Engineers
- Utah Geologic Survey
- Utah Division of Forestry Fire, and State Lands
- Utah Department of Agriculture
- Utah Avalanche Center
- Utah Automated Geographic Resource Center
- University of Utah
- University of Utah Seismic Station
- Utah State University
- Councils of Governments
- Association of Governments
- Davis County and municipalities including the City of Bountiful, Centerville City, Clearfield City, Clinton City, Farmington City, Fruit Heights City, Kaysville City, Layton City, City of North Salt Lake, South Weber City, Sunset City, Syracuse City, West Bountiful City, West Point City, and Woods Cross City
- Davis County emergency manager Brian Law
- Davis County elected officials and planning commission members
- Davis County residents and other interested members
- Davis County agencies including; public works, GIS office, assessors office, LEPC, emergency services division, fire and sheriff's office
- Morgan County and municipalities including Morgan City
- Morgan County emergency manager Terry Turner
- Morgan County elected officials
- Morgan County agencies including; the planning commission, public works, assessors office
- Morgan County residents and other interested members of the public
- Tooele County and municipalities including Grantsville City, Ophir Town, Rush Valley Town, Stockton Town, Tooele City, Vernon Town, and the city of Wendover
- Tooele County emergency managers Kari Sagers, John Michaelson, and Marilyn Candeleria
- Tooele County elected officials
- Tooele County agencies including engineering department, planning commission, assessors office, USU Extension Office, Natural Resource Conservation Service
- Tooele County public and other interested members
- Salt Lake County and municipalities town of Alta, Bluffdale City, city of Draper, Herriman, Holladay-Cottonwood City, Midvale City, Murray City, Riverton City, Salt Lake City, Sandy City, city of South Jordan, city of South Salt Lake, city of Taylorsville, West Jordan City, and West Valley City
- Salt Lake County emergency managers Dennis Stanley, Bob Halloran, Kathy Cuff Case
- Salt Lake County elected officials
- Salt Lake County agencies including public works, GIS departments, engineering departments, planning commission, assessors office, LEPC, emergency services division, fire and sheriff's office
- Salt Lake County public and interested members
- Weber County and municipalities including Farr West City, City of Harrisville, Hooper City, Huntsville City, Marriott-Slaterville, North Ogden City, Ogden City, Plain City, Pleasant View

City, Riverdale City, Roy City, South Ogden City, Town of Uintah, city of Washington Terrace, and West Haven City

- Weber County emergency manager Lance Peterson
- Weber County elected officials
- Weber County agencies including planning commission, GIS department, fire and sheriff's office, emergency services division
  
- In addition, we offer sincere thanks to the Town of Merrimack, Clackamas County, Dunkerton, Iowa, Dunn County North Dakota, Jefferson County West Virginia, and Salt Lake City.

## Table of Contents

<b>Executive Summary</b>	
<b>Acknowledgements</b>	
<b>Part I. Introduction</b>	1
A. Purpose	1
B. Scope	1
C. Authority	2
D. Goals and Objectives	2
<b>Part II. Adoption Process and Documentation</b>	1
<b>Part III. Planning Process</b>	1
A. Public Involvement	6
B. Information Sources	7
<b>Part IV. Regional Data</b>	1
A. Geographic and Physiographic Background	2
B. Geology	3
C. Climate	4
D. Major Rivers	4
E. Development Trends	5
<b>Part V. Capability Assessment</b>	1
<b>Part VI. Risk Assessment</b>	1
A. Hazard Identification	1
B. Hazard Profile	4
C. Vulnerability Analysis	5
D. Mitigation Goals, Objectives, Actions	7
E. Hazard Description	8
<b>Part VII. Davis County</b>	
A. Demographics and Population Growth	1
B. Economy	2
C. Transportation and Commuting Patterns	3
D. Land Use	3
E. Risk Assessment	3
F. Hazard History	26
G. Mitigation Goals, Objectives, Actions	28
H. Maps	36
<b>Part VIII. Morgan County</b>	
A. Demographics and Population Growth	1
B. Economy	2
C. Transportation and Commuting Patterns	3
D. Land Use	3
E. Risk Assessment	3
F. Hazard History	16
G. Mitigation Goals, Objectives, Actions	17
H. Maps	23

<b>Part IX. Salt Lake County</b>	
A. Demographics and Population Growth	1
B. Economy	2
C. Transportation and Commuting Patterns	5
D. Land Use	6
E. Risk Assessment	6
F. Hazard History	26
G. Mitigation Goals, Objectives, Actions	35
H. Maps	44
<b>Part X. Tooele County</b>	
A. Demographics and Population Growth	1
B. Economy	2
C. Transportation and Commuting Patterns	3
D. Land Use	3
E. Risk Assessment	3
F. Hazard History	14
G. Mitigation Goals, Objectives, Actions	15
H. Maps	20
<b>Part XI. Weber County</b>	
A. Demographics and Population Growth	1
B. Economy	2
C. Transportation and Commuting Patterns	3
D. Land Use	3
E. Risk Assessment	4
F. Hazard History	29
G. Mitigation Goals, Objectives, Actions	31
H. Maps	45
<b>Part XII. Regional Hazards</b>	1
<b>Part XIII. Maintenance and Implementation Procedures</b>	
A. Maintenance	1
B. Implementation	2
<b>Appendices</b>	
A. Environmental Considerations	
B. General Mitigation	
C. Critical Facilities	
D. National Flood Insurance Policy	
E. Flood Hazard Identification Study	
F. Mitigation Strategies Workbook	
G. Salt Lake County Critical Facilities affected by Hazards	
H. Glossary of Terms/ Acronyms	
I. Works Cited	

Cover Photo: Elk Point- Mount Timpanogos Avalanche. The debris covers perhaps ten football fields with almost all the debris deeper than 10 feet. The avalanches started way up high, around 10,800' and descended on the people below during one of the largest snow storms in years. US Forest Service- Bruce Tremper 12/27/2003.

## **Part I. Introduction**

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be substantially reduced when attention is turned to mitigating their impacts and effects before they occur or re-occur.

Hazard mitigation is defined as any cost-effective action that has the effect of reducing, limiting, or preventing vulnerability of people, property, and/or the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation actions, which can be used to eliminate or minimize the risk to life and property, fall into three categories: first, those that keeps the hazard away from people, property, and structures; second, those that keeps people, property, and structures away from the hazard; and third, those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation actions must be practical, cost effective, environmentally, and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

Capital investment decisions must be considered in conjunction with natural hazard vulnerability. Capital investments can include; homes, roads, public utilities, pipelines, power plants, chemical plants, warehouses, and public works. These decisions can influence the degree of hazard vulnerability of a community. Once a capital facility is in place very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which ensure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

In the past, mitigation has been the most neglected aspect within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures are neglected in favor of high-profile events. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to greatly reducing long-term risk to people and property living in Utah from natural hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

### **A. Purpose**

The purposes of this plan are as follows; to fulfill Federal, State, and local hazard mitigation planning obligations, to engage in long-term mitigation planning, and to direct mitigation actions which would serve to minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the State of Utah. This plan enhances city and state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability of each Utah jurisdiction.

### **B. Scope**

The WFRC PDM plan was developed in accordance with the requirements of the FEMA Section 322 regulations, DESHS, and local planning agencies.

The goal of this plan is to assist the five counties of the Wasatch Front region (Davis, Morgan, Salt Lake, Tooele, and Weber) in reducing the costs of natural disasters through mitigation practices. This plan provides comprehensive hazard identification, risk assessment, vulnerability analysis, mitigation actions, and an implementation schedule for the region.

Regulations set forth by FEMA were followed during development of this plan. Future monitoring, evaluating, updating and implementation will take place as new incidents occur or every five years.

## C. Authority

**Federal:** Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 (DMA 2000) into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation, if they submit a mitigation plan (which is a summary of local and/or regional mitigation plans) that identifies natural hazards, risks, vulnerabilities, and which describes proposed actions to mitigate the hazards risks and vulnerabilities in that plan.

**State:** The Governor's Emergency Operation Directive, The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended, Title 44, CFR, Federal Emergency Management Agency Regulations, as amended, State Emergency Management Act of 1981, Utah Code 53-2, 63-5, Disaster Response Recovery Act, 63-5A, Executive Order of the Governor, Executive Order 11, Emergency Interim Succession Act, 63-5B.

**Local:** Local governments play an essential role in implementing effective mitigation. Each local government will review all present or potential damages, losses, and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In the counties and cities making up the WFRM the local executive responsible for carrying out plans and policies are the county Commissioners and city or town Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document.

**Association of Governments:** The Association of Governments have been duly constituted under the authority of Title XI, Chapter 13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

## D. Goals and Objectives

The goals and objectives of the PDM plan included coordination with local governments to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document, DESHS planning expectation, and local input. And meet the need of reducing risk from natural hazards in Utah, through the implementation of and updating of regional plans.

**Local Goals:** These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities

- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains

**Long Term Goals:**

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks
- Avoid risk of exposure to identified hazards
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result of identified hazards
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized
- Provide a basis for funding of projects outlined as hazard mitigation strategies
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources

**Objectives:** The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agency or organization responsible for implementation
- Projecting a time frame for implementation
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available
- Identifying alternative measures, should financing not be available
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal
- Property, damage to critical facilities, economic loss, and hardship or human suffering
- Meet applicable permit requirements
- Not encourage development in hazardous areas
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem
- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation
- Have manageable maintenance and modification costs
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement
- Whenever possible, use existing resources, agencies and programs to implement the project

## Part II. Adoption Process and Documentation

The WFRC PDM plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 of the local hazard planning regulations the final plan was to be adopted by each of the municipalities as well as the five counties. This section documents the adoption process of each local government in order to demonstrate compliance with this requirement. The plan was adopted prior to being submitted to FEMA region VIII for final review. Table 1 identifies the communities that participated in the planning process and have adopted the plan. The following is a sample of the Adoption Resolutions.

**Table 1 Participating Communities**

Counties	Participated (Yes/ No)	Date
<b>Davis County</b>		
City of Bountiful		
Centerville City		
Clearfield City		
Clinton City		
Farmington City		
Fruit Heights City		
Kaysville City		
Layton City		
City of North Salt Lake		
South Weber City		
Sunset City		
Syracuse City		
West Bountiful City		
West Point City		
Woods Cross City		
<b>Morgan County</b>		
Morgan City		
<b>Salt Lake County</b>		
Town of Alta		
Bluffdale City		
City of Draper		
Herriman		
Holladay- Cottonwood City		
Midvale City		
Murray City		
Riverton City		
Salt Lake City		
Sandy City		
City of South Jordan		
City of South Salt Lake		
City of Taylorsville		
West Jordan City		
West Valley City		
<b>Tooele County</b>		
Grantsville City		

Ophir Town		
Rush Valley Town		
Stockton Town		
Tooele City		
Vernon Town		
City of Wendover		
<b>Weber County</b>		
Farr West City		
City of Harrisville		
Hooper City		
Huntsville City		
Marriott-Slaterville		
North Ogden City		
Ogden City		
Plain City		
Pleasant View City		
Riverdale City		
Roy City		
South Ogden City		
Town of Uintah		
City of Washington Terrace		
West Haven City		

RESOLUTION NO. \_\_\_\_\_

**A RESOLUTION ADOPTING THE WASATCH FRONT REGIONAL COUNCIL NATURAL HAZARD PRE-DISASTER MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.**

WHEREAS, President William J. Clinton signed H.R. 707, the Disaster Mitigation and Cost Reduction Act of 2000, into law on October 30, 2000.

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds,

WHEREAS, Wasatch Front Regional Council (WFRC) has been contracted by the State of Utah to prepare a Pre-Disaster Mitigation Plan covering all of the jurisdictions in the WFRC area, and

WHEREAS, the WFRC Executive Council approved WFRC staff to write the plan on February 21, 2002, and

WHEREAS, XXX City is within the WFRC Area, and

WHEREAS, the XXX City Council is concerned about mitigating potential losses from natural hazards/ disasters before they occur, and

WHEREAS, the plan identifies potential hazards, potential losses and potential mitigation measures to limit losses, and

WHEREAS, the XXX City Council has determined that it would be in the best interest of the community as a whole to adopt the Natural Hazard Pre-Disaster Mitigation Plan as it pertains to the City, therefore

BE IT RESOLVED BY THE XXC CITY COUNCIL THAT:

The attached "Wasatch Front Regional Council Natural Hazard Pre-Disaster Mitigation Plan" be adopted to meet the requirements of the Disaster Mitigation and Cost Reduction Act of 2000.

This resolution shall be effective on the date it is adopted.

DATED this \_\_\_\_\_ day of \_\_\_\_\_, 2003.

\_\_\_\_\_  
Mayor  
XXX City

ATTEST:

\_\_\_\_\_  
Recorder

## Part III. Planning Process

This plan was prepared in the offices of the WFRC by appointed staff members LaNiece Dustman, Lane Nielson, and Jim Boes and was supported by the local planning team members of the Emergency Management Service Divisions and other state and local personnel. Other local agencies that have aided in the process include; City and County Geographic Information Systems (GIS) Departments, Elected Officials, Local Officials, Emergency Managers, Fire and Sheriff Departments, Planning Departments, and Local Governmental Agencies. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and supporting guidance documents developed by FEMA and the Utah DESHS.

The planning process included the following steps.

1. Organize Resources
2. Public Officials Out Reach
3. Establish Continuity in Planning Process
4. Data Acquisition
5. County Hazard Identification and Profile
6. County Vulnerability Assessment
7. Local Mitigation Actions
8. Form County Mitigation Steering Committee
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

### Step 1: Organize Resources

The seven regional Association of Governments (AOG) were recommended to conduct the planning efforts by the Utah League of Cities and Towns and the Governors Office of Planning and Budget to ensure coordination with elected officials, emergency managers, planners, public works departments, and information technology specialists. Utah DESHS contracted the seven AOG's as sub-grantees to coordinate, develop, and write the seven multi-regional hazard mitigation plans under the planning guidelines included in the DMA 2000.

WFRC designated a core planning team made up of members outlined in Table 3-1. These members were the main constituents of the planning process from the initiation of the plan, to the development and coordination, and resolution of the plan's adoption. In addition to the core planning team a technical team committee was created on a technical level that is identified in Table 3-2. A local committee was also established to ensure local input and is identified in Table 3-3.

**Table 3-1 Core Planning Team**

<b>Name</b>	<b>Organization</b>
Lane Nielson	Wasatch Front Regional Council, Community Development and Planner
LaNiece Dustman	Wasatch Front Regional Council, Hazard Mitigation Planner
Jim Boes	Wasatch Front Regional Council, Planner

**Table 3-2 Technical Team Committee**

<b>Name</b>	<b>Organization</b>
Ryan Pietramali	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council

Jeff Adams	Southeastern Utah Association of Local Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

**Table 3-3 Local Planning Team**

<b>County Name</b>	<b>Member Name</b>	<b>Organization Name</b>
<b>Davis</b>	Sgt. Brian Law	Sheriffs Office, Emergency Services
	Floyd Peterson	Clinton City Fire Department
	Larry Gregory	Farmington City Fire Department
	Kirk Middaugh	Department Public Safety, Utah Highway Patrol
	Dave Adamson	Davis County Public Works
	Paul Child	Centerville City Public Works
	Dustin Lewis	Centerville City
	John Thacker	Kaysville City
	Walt Hokanson	Farmington City
	Bret Millburn	Red Cross
	Norm Whitaker	West Point City
	John Mabey	Utah Amateur Radio Emergency Services
	Anne Blenkinship	Woods Cross City
	Farrell Cook	West Point City
	John Massengale	South Weber City
	Jim Mason	Layton City
<b>Morgan</b>	Terry Turner	Sheriffs Office, Emergency Services
	Kim Turner	Fire Department, Emergency Services
<b>Salt Lake</b>	Dennis Stanley	Emergency Services/ Fire Department
	Bob Halloran	Emergency Services
	Joan Welch	Emergency Services
	Nancy Sanchez	Salt Lake Community College
	Randy Willden	Murray Fire Department
	Stephen Higgs	Midvale Fire Department
	Dawn Black	Salt Lake City Emergency Management
	David Chishaun	City of Holladay
	Chris Evans	South Jordan Public Safety
	Kathy Cuff-Case	Emergency Services
	Kent Miner	Salt Lake Valley Health
	Kari Sagers	Emergency Management
	John Michaelson	Emergency Management
	Dana Truman	Natural Resources Conservation Society
	Matt Palmer	Utah State University Extension Service
	Nicole Cline	Tooele County Engineers Office
<b>Weber</b>	Lance Peterson	Sheriffs Office, Emergency Services
	George Burbidge	Weber Co. Stormwater
	Chuck Stokes	Weber Fire Department
	Jack Lucero	Weber Fire District
	Curtis Christenson	Weber County Engineer
	Jay Miller	Emergency Manager
	Delon Atkinson	Emergency Service Director

**Step 2: Public Officials Outreach**

To ensure the planning process had backing from the elected officials a representative from WFRC met with each local elected officials to inform them of the need for the plan and how it can better help their communities. The plan was introduced to local elected official along with public entities through a series of public meeting and an informational brochure created by the WFRC.

**Step 3: Establish Continuity in the Planning Process**

To meet the requirements set forth by DMA 2000, the seven AOG's were contracted by the DESHS to assist all counties within Utah in completing the seven multi-regional PDM plans. The seven AOG's formed a Technical Team Planning Committee to share ideas and ensure the plans were similar and that there was little duplication of effort.

**Step 4: Data Acquisition**

Contact was made with the GIS technician or planning commission in each city and county to assess what data was available on a local level. Agreements were put in place to allow the exchange of data between the local jurisdictions and WFRC. Data layers obtained included some or all of the following: local roads, plot maps, county tax assessor's data, hazard data, flood maps, topographic data, aerial photographs, and land development data.

**Step 5: County Hazard Identification and Profile**

These steps were conducted by gathering data on the hazards that occurred within the planning region. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other local media accounts, state and local weather records, conversations with the public and local officials, surveys, interviews, and meetings with key informants within the planning area. Mitigation planning meetings were held during this process and are explained in further detail in Table 3-4. During these meetings attendees had the opportunity to review the general information on previous hazards and comment on them in a more specific manner. These meetings also provided a forum for discussion on the background information that was needed to gain a general understanding of the geography, geology, recreation, natural resources, and water resources of the planning region. These initial contacts with local entities also provided visual understanding of the planning region for planners of the core planning team.

**Step 6: County Vulnerability Assessment**

This step was conducted through a review of local base maps, topographical maps, floodplain maps, USGS and UGS maps, AGRC maps, FEMA hazard maps, and county hazard maps. A detailed vulnerability assessment was completed with the use of GIS software for each county within the WFRC planning region. HAZUS MH was used to determine vulnerability to earthquakes, floods, landslides, and wildfire. Loss estimation methodology was developed by the core planning team, with assistance from the technical team, to determine vulnerability from each identified hazard. When available county parcel data was used to estimate the number of residents that could be affected by the hazard. If county parcel data was unavailable then Census 2000 block data was used.

**Step 7: Local Mitigation Actions**

This step was conducted through a review of the governing documents of the planning region, as well as, conversations, interviews, and meetings with interested community members. This step identified what goals are already established and adopted for the planning area and whether or not they promote or deter mitigation activities.

**Step 8: Form County Mitigation Steering Committee**

Davis, Morgan, Tooele, Weber, and Salt Lake Counties all set up a mitigation planning steering committee. These committees were formed of individuals with an interest in mitigation, as well as, public employees with technical expertise pertinent to mitigation. These committees included elected officials, city planners, city engineers, county and city GIS staff, floodplain managers, sheriff and fire staff, and city and county emergency managers. Committee members were tasked with completing the Mitigation Strategies Workbook issued by the DESHS.

**Step 9: Mitigation Strategy Development**

Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each county that participated in the PDM Planning Grant was asked to evaluate identified and profiled hazards, and the vulnerability assessment completed by WFRC. This information was used to complete the Mitigation Strategies Workbook found in Appendix H.

**Step 10: Prioritization of Identified Mitigation Strategies**

The DMA 2000 requires state, tribal, and local governments to show how mitigation actions were evaluated and prioritized. The core planning team, the technical team, and the local planning team completed this process. Prioritization was done using the STAPLEE method explained in the FEMA How to Guide, Document 386-3.

**Step 11: State Review**

DESHS created a formal PDM plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the plans from October 15 through November 1, 2003 and again from January 1 to January 15, 2004 subsequent to submission to FEMA for final review and acceptance.

**Step 12: Adoption**

The plan went through a public hearing process on (date) and was adopted by the cities and counties listed in Table 1 of Part II. Adoption Process and Documentation.

**Table 3-4 Planning Process Timeline**

<b>Date</b>	<b>Activity</b>	<b>Purpose</b>
March 29, 2002	Letter of Intent that identifies the seven Association of Governments as sub-grantees of the state to write the PDM plans. The AOG's were chosen by the Utah Interagency Technical Team who is part of Nature-Safe Utah (Utah's Pre-Disaster Mitigation Program).	Continue the relationship with local council members and municipalities.
May 15-16, 2002	Utah's first regional mitigation planning training piloted toward the seven AOG's	Establish a guideline and timeframe.
July 12, 2002	News Release from Governor Michael Leavitt announcing the new program to develop local hazard mitigation plans statewide.	Conduct public awareness and involvement.
August, 2002	Gather information.	Data Collection.
September 10, 2002	Meeting. Met with all AOG's and DESHS to discuss the planning process.	Identify planning team and available resources.
September 30, 2002	Public Meeting. Met with Emergency Managers in the Wasatch Front region.	Identify level of involvement.
October 31, 2002	Meeting. Met with DESHS.	Discuss timeline and planning process.
November 2002	Gathered community data for regional data section of the plan.	Data Collection.
November 12, 2002	Public Meeting. Met with Uintah Basin Association of Governments.	Identify sub-committees.
November 14, 2002	Public Meeting. Met with Six County Association of Governments.	Identify sub-committees.

November 18, 2002	Public Meeting. Carbon County meeting with local and state DESHS, city and county officials including Helper City Fire Department, Wellington community member, Price City Emergency Preparation Committee, Carbon County emergency manager.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
November 18, 2002	Public Meeting. Emery County meeting with public safety officials from Orangeville City, Building Inspector from Huntington City, Emery City, Clawson City, Cleveland City, Elmo City and Ferron City mayor's. Sheriff and Road Department from Emery County, Castle Dale city planning and zoning, Huntington City and Green River City local community members.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
November 22, 2002	Meeting. Met with technical team members.	Solicit public involvement, Army Corps proposal for flood study, GIS training, timeline, review the regional plans
December, 2002	Gathering data.	Data Collection
January, 2003	Gathering data.	Data Collection.
January 22, 2003	Public Meeting. AOG executive director's meeting.	Signed contracts for Army Corps flood proposal.
February 13, 2003	Public Meeting. Grand County (in Moab and Monticello cities) local community member meeting. GIS staff, geologist, planning commission, hydrologist, state DESHS, AOG's staff members all attended the meeting.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
February 13, 2003	Public Meeting. San Juan County community member meeting. Met with GIS staff, state DESHS, local AOG members, and county emergency manager.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
February 27, 2003	Meeting. Met with technical team members in St. George.	Review of plans, mapping.
March, 2003	Information gathering	Data Collection, plan
April 21, 2003	Meeting. AOG executive director's meeting.	PDM extension and additional money.
April, 2003	Drafting of the plan.	For review.
May 16, 2003	Meeting. AOG executive directors meeting.	Discussion of progress; plans to DESHS by December with additional money.
May 22, 2003	Meeting. Met with technical team members at DESHS.	Progress report, deadlines, mapping, mitigation actions, internal web page.
May, 2003	Gather mapping data.	Complete hazard identification and profile.

June, 2003	Website addressing Natural Hazards.	Public involvement and comment.
July 17, 2003	Meeting. Met with technical team member in Orem City.	Discussed mapping and plan review.
August, 2003	Public meetings. Handed out pamphlets about PDM.	Public involvement.
September 25, 2003	Meeting. Technical Team Member meeting.	Army Corps of Engineers Flood Study review, training.
October 15, 2003	Technical Team Training. Pre-Disaster Mitigation Training provided by DESHS.	Informational meeting regarding FEMA requirements, ideas on mitigation strategies.
October 15, 2003	Plan Submission.	Turned plans into DESHS for review.
November 4, 2003	Local Planning Team Meeting/ Mitigation Strategies. Weber County.	Identified local planning team for Weber County. Local mitigation actions were identified.
November 13, 2003	Local Planning Team Meeting/ Mitigation Strategies. Tooele County	Identified local planning team for Tooele County. Local mitigation actions were identified.
November 20, 2003	Local Planning Team Meeting/ Mitigation Strategies. Davis County	Identified local planning team for Davis County. Local mitigation actions were identified.
November 20, 2003	Local Planning Team Meeting/ Mitigation Strategies. Morgan County	Identified local planning team for Morgan County. Local mitigation actions were identified.
November 30, 2003	Local Planning Team Meeting/ Mitigation Strategies. Price City.	Second mitigation strategies workbook meeting for Price City.
December 3, 2003	Local Planning Team Meeting/ Mitigation Strategies. Tooele County	Second mitigation strategies workbook meeting.
December 3, 2003	Local Planning Team Meeting/ Mitigation Strategies. Salt Lake County	Identified local planning team for Salt Lake County. Local mitigation actions were identified.
December 10, 2003	Met with Utah DESHS for review.	Track progress.
December 31, 2003	Turned plan into Utah DESHS for final State review.	State review.

## A. Public Involvement

Public involvement opportunities were available and incorporated throughout the development of this plan. Such opportunities included a public website and public meetings for comment review. Emergency managers, fire and sheriff departments, state and local agencies, business leaders, educators, non-profit organizations, private organizations, and other interested members that could be affected by a hazard within the region or other interested members, were all a part of the planning process.

Following the preliminary FEMA approval, this Natural Hazard Mitigation Plan was placed on the Utah Division of Emergency Services and Homeland Security, and the Wasatch Front Regional Council websites for further public comment and review. These websites were placed in the local paper (Salt Lake Tribune and/ or the Deseret News) for public advertisement and awareness. In addition, interested members were notified through email or phone of the comment period. Such members included Emergency Services and Managers, Fire and Sheriff's departments, Public Works department, American Red Cross, Utah Geological Survey, Planning Commissions, Planning Agencies, GIS departments, and other Association of Governments.

## B. Information Sources

The following sources and plans were used and reviewed while completing the plan.

- Federal Emergency Management Agency (How-to Guides).
- National Weather Service (hazard profile).
- National Climate Data Center (drought, severe weather)
- Army Corps of Engineers (flood data).
- Utah Division of Emergency Services and Homeland Security (Salt Lake City Mitigation Plan, GIS data, flood data, HAZUS data for flood and earthquake).
- Utah Geologic Survey (GIS data, geologic information).
- Utah Division of Forestry Fire and State Lands (fire data).
- Utah Avalanche Center, Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service.
- Utah Automated Geographic Resource Center (GIS data).
- University of Utah (drought climate charts from internship students).
- University of Utah Seismic Station (earthquake data).
- Utah State University (climate data).
- Councils or Government
- Association of Governments
- Davis County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Morgan County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, transportation data, property and infrastructure data).
- Tooele County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, transportation data, property and infrastructure data).
- Salt Lake County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Weber County and municipalities (Emergency Operations Plan, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data, parcel data, county projects, county plans).
- Earthquake Safety in Utah
- Utah Natural Hazard Handbook
- Utah Statewide Fire Risk Assessment Project
- A Strategic Plan for Earthquake Safety in Utah
- Natural Disaster Analysis, State of Utah Office of Emergency Services 1976
- State of Utah Mitigation Plan 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Salt Lake City Vulnerable Analysis and Multi-Hazard Mitigation Plan 2002
- Ogden Valley General Plan
- Regional Storm Water Management Plan Weber County, UT 1999
- Planning for a Sustainable Future
- Town of Merrimack, NH Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Hazard Mitigation Plan Dunkerton, Iowa
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001
- Jefferson County West Virginia All Hazard Mitigation Plan 2003

## Part IV. Regional Data



The Wasatch Front is made up of Davis, Morgan, Salt Lake, Tooele, and Weber counties. All are very distinct in regards to geography, population, and economy. Salt Lake County is the most urbanized county in the region as well as the entire state whereas Tooele County is the least urbanized within the region. Table 4-1 identifies each cities population using Census 2000 data.

**Table 4-1 Municipalities within Wasatch Front Regional Council**

Davis County	2000 City Pop.	Morgan County	2000 City Pop.	Salt Lake County	2000 City Pop.	Tooele County	2000 City Pop.	Weber County	2000 City Pop.
City of Bountiful	41,301	Morgan City	2,635	Town of Alta	370	Grantsville City	6,015	Farr West City	
Centerville City	14,585			Bluffdale City	4,700	Ophir Town	23	City of Harrisville	
Clearfield City	25,974			City of Draper	25,220	Rush Valley Town	453	Hooper City	
Clinton City	12,585			Herriman	1,523	Stockton Town	443	Huntsville City	
Farmington City	13,000			Holladay-Cottonwood City	14,561	Tooele City	22,502	Marriott-Slaterville	
Fruit Heights City	5,400			Midvale City	27,029	Vernon Town	236	North Ogden City	15,026
Kaysville City	20,351			Murray City	34,024	City of Wendover	1,537	Ogden City	77,226
Layton City	58,474			Riverton City	25,011			Plain City	
City of North Salt Lake	10,000			Salt Lake City	181,743			Pleasant View City	5,632
South Weber City	4,500			Sandy City	88,418			Riverdale City	7,656
Sunset City	5,200			City of South Jordan	29,437			Roy City	32,885
Syracuse City	10,000			City of South Salt Lake	22,038			South Ogden City	14,377

West Bountiful City	5,000			City of Taylorsville	57,439			Town of Uintah	
West Point City	7,300			West Jordan City	68,336			City of Washington Terrace	8,551
Woods Cross City	6,000			West Valley City	108,896			West Haven City	
Unincorporated	2,500								

## A. Geographic and Physiographic Background

**Davis County** is located in the northern region of Utah and encompasses approximately 633 square miles. Two thirds of the land area is covered by the Great Salt Lake allowing for only 233 square miles of usable land. The Great Salt Lake is the largest water body within the state and was named the Great Salt Lake because of the high salt content. Davis County is bordered by the Wasatch Mountain Range to the east, Weber County and the Weber River to the northeast, the Great Salt Lake to the west, and Salt Lake County to the south (Davis County Emergency Operations Plan).

**Morgan County** is located just east of Davis County in the northern portion of the state. It is the third smallest county making up only 610 square miles. Morgan County's landscape includes the Wasatch Mountain Range, steppe valleys, the Weber River, which is one of the main river valleys in northern Utah. Two smaller tributaries also run through the county, namely East Canyon and Lost Creek. Morgan County also has farming and grazing lands and is bordered to the east by Summit County. The county's elevation ranges from 4,895 feet above sea level at Mountain Green to 9,547 feet above sea level at Francis Peak. Morgan City and Mountain Green are the most populated cities within the county (Morgan County Emergency Operations Plan).

**Salt Lake County** is the largest county in terms of population in the state and is the State Capital. Salt Lake County is in the middle of two mountain ranges, the Oquirrh Mountains to the west and the Wasatch Range to the east. The southern border is the Traverse Mountain Range, which is 10 miles long. The valley floor is about 35 miles long from Davis County to the north and to the point of the mountain to the south, and 33 miles wide from the Oquirrh Mountains from the west to the Wasatch Range on the east. The County is made up of 764 square miles of mountains, valleys, farming, grazing lands, and the Great Salt Lake. The elevation ranges from the historical low of the Great Salt Lake in 1963 of 4,193 feet MSL, to the highest point of the planning region in the Wasatch Range which is 11,330 feet above sea level at Twin Peaks.

The Jordan River is one of the main river drainages in the county and flows north through the middle of the valley to the Great Salt Lake. Other surface water drainages include Big Cottonwood Creek, Little Cottonwood Creek, Mill Creek, Parleys Creek, Emigration Creek, Red Butte Creek and City Creek. All the surface flow drains into the Great Salt Lake, which also receives inflow from the Weber and Bear Rivers (Salt Lake County Emergency Operations Plan).

**Tooele County** is the second largest county in Utah, with 6,923 square miles of area. Salt Lake and Utah Counties bound it to the east. The southern border is Juab County, the northern border is Davis and Box Elder Counties, and the western border is the State of Nevada. Three fourths of the population lives in the eastern valleys where most of the irrigated and dry farmland is located. The western sectors make up the Great Salt Lake desert and are more arid and generally uncultivated. Altitudes range from the Great Salt Lake to 11,031 feet above sea level at the top of Mount Deseret in the Stansbury Mountains (Tooele County Emergency Operations Plan).

**Weber County** is located in the north-central part of the state and is the second smallest county in terms of land area, yet the fourth largest in terms of population. Weber County has a total of 662 square miles. The Great Salt Lake covers approximately 112 square miles of the county's land. Elevation ranges from the

Great Salt Lake to over 9,700 feet above sea level at Ben Lomond Peak. The eastern half of Weber County is a high alpine valley and a mountain area, while the western portion is a flat fertile plain formed by alluvial deposits from Lake Bonneville. The Weber River and its tributaries the Ogden River, Coldwater Creek, Burch Creek and several other smaller creeks, are the main river drainages. The Weber River drainage covers approximately 2,460 square miles of land (Weber County Emergency Operations Plan).

## B. Geology

The Wasatch Front Region is comprised of the Wasatch, Uintah, Oquirrh, and Stansbury Mountain Ranges. The Wasatch Mountain Range runs north south and is the eastern border of the valley region of the Wasatch Front. The Uintah Mountain Range runs east west and is the eastern most range of the Great Basin, which is part of the much larger Basin and Range province. The Oquirrh Mountain Range is the border between Salt Lake and Tooele County. The Stansbury Mountains are in the western portion of Tooele County.

The geology of this region is a product of Miocene Epoch faulting and folding followed by a period of upheaval. The upheaval raised the valley 3,000 to 5,000 feet in a dome like manner during the Tertiary Period. This disturbance of the valley floor created a tension and a build-up of stress. To accommodate for the change “block-faulting” occurred that allowed for the uplift of the mountain ranges and depression of the valley floor. This depression extends to the lowest portion of the Wasatch Front Region, the Great Salt Lake. Erosion is now the main process of this area.

The Uintah and Wasatch Range are comprised of mainly Tertiary lake deposits and Tertiary and Quaternary volcanic rocks as well as younger Precambrian sedimentary rocks. To the north of Salt Lake City on the Wasatch Front, the hardest, highly altered metamorphosed rocks of schist and gneiss are found and date back about 2.6 billion years. Paleozoic marine sedimentary rocks surround the Precambrian areas of the Range. The Paleozoic sedimentary rocks have a very weak make-up and in conjunction with Utah’s heavy precipitation during the winter and summer months many landslides, avalanches, debris flows, and rock falls occur. Refer to Table 4-2 for an explanation of the geologic time scale.

The north end of the Oquirrh Mountain group is almost entirely Pennsylvanian and Permian sedimentary rock. The south end of the Oquirrh Mountains is made up of Tertiary granite and is home to the largest open mine pit, the Bingham Copper Mine. The Salt Flats in the western portion of Tooele County are a remnant of Lake Bonneville’s fine compressed sediment and made up of salt that includes the mineral makeup of gypsum, potash, and calcium carbonate.

**Table 4-2 Geologic Time Scale**

Ages or Eras	Millions of Years Ago	Period	Epoch
CENOZOIC	0-1.8	QUATERNARY	Holocene
			Pleistocene
	1.8-65	TERTIARY	Pliocene
			Miocene
			Oligocene
			Eocene
			Paleocene
MESOZOIC	65-145	CRETACEOUS	Late
			Early
	145-213	JURASSIC	Late
			Middle
			Early
	213-248	TRIASSIC	Late
			Middle
			Early
PALEOZOIC	248-286	PERMIAN	Late

				Early
	286-360	CARBONIFEROUS	PENNSYLVANIAN	Late
			MISSISSIPIAN	Early
	360-410	DEVONIAN		Late
				Middle
				Early
	410-440	SILURIAN		Late
				Middle
				Early
	440-505	ORDOVICIAN		Late
				Middle
				Early
	505-544	CAMBRIAN		Late
				Middle
				Early
PRE-CAMBRIAN	544-4.5 billion years ago, time from the beginning of earth.			
Source: U. S. Geological Survey, Paleontology website: <a href="http://geology.er.usgs.gov/paleo/">http://geology.er.usgs.gov/paleo/</a>				

## C. Climate

Northern Utah is considered a desert climate. Utah has hot dry summers and cold winters. However Utah's climate is variable, it can be wet in one portion of the state and dry in another. This is a function of latitude, elevation, topography, and distance from moisture sources. The Wasatch Front region's climate borders a semi-arid, mid-latitude steppe climate that occurs along the perimeter of the Great Basin Desert, and a humid continental climate found at slightly higher elevations in the Rocky mountain foothills (Critchfield, 1974).

Utah has four seasons, low annual precipitation, convective and frontal storms, dry summers, low humidity, and large annual and diurnal temperature extremes. The Wasatch Mountain Range brings most of the precipitation to the valley floor. The winter months bring heavy snow accumulation over the mountains that are favorable for winter sport activities. Spring runoff is at its peak from April thru June and can cause flooding along the lower streams. Flash flooding affects smaller more localized areas in this region from summer thunderstorms.

The average annual precipitation in the Wasatch Mountain Range can be more than 40 inches, while the Great Salt Lake Desert receives on average less than 5 inches annually. The average accumulation at the Salt Lake International Airport is 15.3 inches of rainfall and 58.9 inches of snowfall. Utah is the second driest state in the nation.

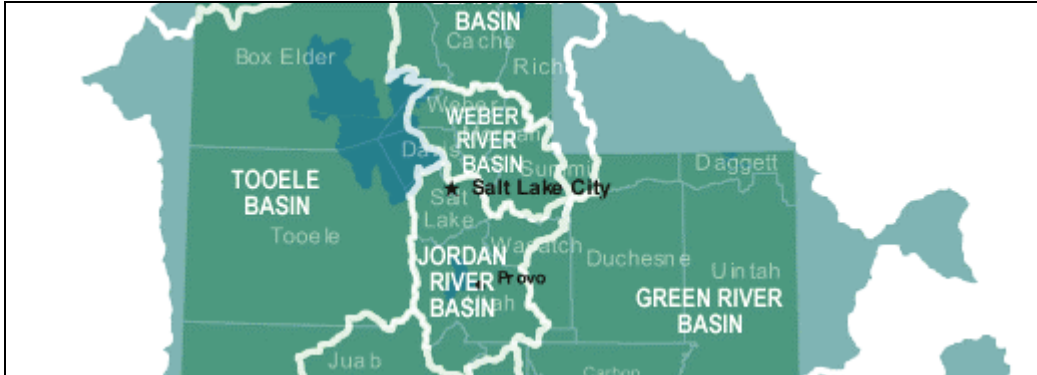
The surrounding mountain ranges act as a barrier to the cold continental arctic masses. This also insulates the area during the day and cools the area rapidly at night. On clear nights the colder air accumulates on the valley floor, while the foothills and benches remain relatively warm.

During the fall and winter months smoke, haze, and fog can accumulate in the lower levels of stagnant air over the valley floor and can last for several weeks at a time. This is because areas of sinking air or high-pressure anticyclones settling over the Great Basin.

Wind speeds are usually light to moderate meaning they range usually below 20 miles per hour. Strong winds can occur in localized areas, mainly in canyon mouths along the western slopes of the Wasatch Mountains and dust storms can occur in the western portions of the region. Tornadoes have occurred in this region but there are generally few. Hailstorms have also occurred in the region during the spring and summer months.

## D. Major Rivers

Most of Utah's water is from snowmelt that occurs during the spring and summer. The larger drainage or river basins are formed from the mountain ravines or depressions that merge into perennial rivers and then meet forming the larger drainages. The Greater Wasatch Front Area includes the Jordan River Basin and portions of the Weber River, Utah Lake, West Desert and Bear River Basins.



Source: US Geological Survey, US Department of the Interior. December 2003. <<http://ut.water.usgs.gov/Basins/index.html>>

Agricultural irrigation is the primary use of developed water in Utah, but municipal, industrial, environmental and recreational uses are increasing and this competition will reform the way water is utilized. With the growing population agricultural land has been decreasing and residential and commercial areas are on the rise. According to the Utah Water Plan the Jordan River, Utah Lake and the Weber River basins are all projected to lose a significant amount of agricultural lands over the next few decades.

### Water and Drought

Utah is the second driest states in the nation and ranks second in per capita water use of public supplies. According to the USGS Utah has experienced drought conditions since 1999 on a statewide level. Decreased flow from major rivers has led to a decline in most of the reservoir levels and in the Great Salt Lake. The current drought is unusual because of the severity. The 2002 water year was one of the driest ever recorded.

## E. Development Trends

All counties in the Wasatch Front Region of Northern Utah (Davis, Morgan, Salt Lake, Tooele, and Weber) will continue to grow. In general, the “developable” areas are bounded by the Great Salt Lake and the Stansbury Mountains to the west, the Wasatch Mountains to the east, Utah County to the south and Box Elder County to the north. The table below projects population growth in Davis, Salt Lake, and Weber counties (Table 4-3).

**Table 4-3**

<b>Area</b>	<b>2000 Population</b>	<b>2010 Population</b>	<b>2020 Population</b>	<b>2030 Population</b>	<b>% Growth 2000-2030</b>
Davis County	238,994	292,201	347,412	386,672	61.8%
Salt Lake County	898,387	1,077,556	1,283,784	1,431,843	59.4%
Weber County	196,533	237,877	286,919	320,770	63.2%
<b>Region</b>	<b>1,333,914</b>	<b>1,607,634</b>	<b>1,918,115</b>	<b>2,139,285</b>	<b>60.4%</b>
<b>Area</b>	<b>2000 Households</b>	<b>2010 Households</b>	<b>2020 Households</b>	<b>2030 Households</b>	<b>% Growth 2000-2030</b>
Davis County	71,201	95,281	119,094	138,092	93.9%
Salt Lake County	295,141	371,312	458,906	528,491	79.1%
Weber County	65,698	81,414	99,699	113,835	73.3%
<b>Region</b>	<b>432,040</b>	<b>548,007</b>	<b>677,699</b>	<b>780,418</b>	<b>80.6%</b>
<b>Area</b>	<b>2000 HH Size</b>	<b>2010 HH Size</b>	<b>2020 HH Size</b>	<b>2030 HH size</b>	<b>Change 2000-2030</b>
Davis County	3.36	3.07	2.92	2.80	-0.56
Salt Lake County	3.04	2.90	2.80	2.71	-0.33
Weber County	2.99	2.92	2.88	2.82	-0.17
<b>Region</b>	<b>3.09</b>	<b>2.93</b>	<b>2.83</b>	<b>2.74</b>	<b>-0.35</b>
<b>Area</b>	<b>2000 Employment</b>	<b>2010 Employment</b>	<b>2020 Employment</b>	<b>2030 Employment</b>	<b>% Growth 2000-2030</b>
Davis County	84,839	106,039	124,662	136,965	61.4%
Salt Lake County	545,052	665,115	781,221	858,158	57.4%
Weber County	88,370	111,556	135,921	153,148	73.3%
<b>Region</b>	<b>718,261</b>	<b>882,710</b>	<b>1,041,804</b>	<b>1,148,271</b>	<b>59.9%</b>

Davis, Salt Lake, and Weber counties have been known as the urban core of the Wasatch Front Region. Traditionally, almost all growth has occurred in these three counties, however, now Morgan and Tooele counties are experiencing more growth and development pressures.

Morgan County's growth is likely to be not as dramatic as growth in Davis, Salt Lake, and Weber counties. Morgan County's motto is "The Best of Rural America." Morgan County is sometimes referred to being part of the "Wasatch Back" (with Summit and Wasatch counties). The "Wasatch Back" is facing great development pressures while still desiring to maintain a rural lifestyle.

Morgan County's growth has been almost all residential on previous agricultural parcels. Some residential growth has occurred on sensitive soils in the Mountain Green area. Most residents commute to work in Weber, Davis, and Salt Lake counties. Morgan County is working on economic development to diversify and expand its tax base with the desire to also maintain their rural lifestyle. Like the Ogden Valley area of Weber County, property values continue to escalate.

Tooele County has been experiencing some of the strongest residential growth in the State. Most of Tooele County's growth is residential, occurring in the Tooele/Grantsville area. Tooele County has become an affordable housing bedroom community for Salt Lake County. Tooele is one of the fastest growing counties in the State.

Salt Lake County is continuing to infill with residential growth between the Kennecott Copper properties on the Oquirrh Mountains to the west and the Wasatch National Forest Property on the Wasatch Mountains to the east.

Davis County's residential growth will continue to infill previous agricultural and industrial fringe. Some of the residential growth appears to be occurring on more sensitive lands such as hillsides and low lying areas towards the Great Salt Lake. Most growth is occurring in northern Davis County. A major political push is occurring to develop a second north/south transportation route adjacent to the Great Salt Lake.

Weber County's residential growth has been moving west closer to the Great Salt Lake. Growth pressures and demand for a rural atmosphere continue to inflate property values in the Ogden Valley. As growth has occurred in west Weber County, concern for the quantity and quality of ground water has escalated. The Weber-Morgan Health Department has been pursuing funding for a ground water study in west Weber and Morgan counties.

Population growth in the planning region is attributed primarily to residents having children. Some residential growth is attributed to in-migration, particularly from California. Nationally, growth is occurring in the west and in the south. The region's population is projected to continue to increase exponentially. This will result in housing cost increases greater than the rate of inflation. Higher population densities are projected to be concentrated in currently developed areas with recent development occurring at lower densities in the outlying areas.

New commercial development is projected in South Jordan City, Riverton City, and Tooele County. Dispersed areas of commercial development are starting to appear, such as in the Fort Union/Union Park area, the Cottonwood Corporate Center, and the Jordan Landing. Small pockets of neighborhood scale commercial development are expected throughout the region in an effort to adhere to Envision Utah principles in making neighborhoods more pedestrian-friendly.

#### **Development Constraints/Opportunities**

Influences on development are many and interrelated. A few are geographic, historic layout, transportation, household size, technology, employment trends, and public policy. Development influences can encourage and/or discourage growth. For example, floodplains, wetlands, slopes and faults, sensitive species, and transportation influences attract and detract development.

### **Geographic**

Geographic constraints on the urban area have created a linear region that stretches more than 60 miles north to south, from the city of Pleasant View in the north to Bluffdale City in the south. At its widest, it is only 15 miles wide. This unique geographic layout has resulted in the development of a transportation system that is focused on the north-south movement of goods and people.

### **Floodplains**

There are a number of identified floodplains in the region that pose challenges, command respect, and generate appeal for development. The three urbanized counties of Weber, Davis, and Salt Lake, are bisected by numerous rivers and streams, which emanate from the mountains and flow westward into the Great Salt Lake. In Weber County, the Ogden/Weber River system is the most significant. In Morgan County the Weber River is the most significant. Hardscrabble Creek, Deep Creek, Lost Creek, East Canyon Creek, and Cottonwood Creek are smaller tributaries within Morgan. In Davis County, several smaller creeks, such as Kays, Farmington, Davis, Deuel, North Canyon, and other Creeks flow from the mountains into the lake. In Salt Lake County, streams from the major mountain canyons flow into the Jordan River, which flows through the middle of the Salt Lake Valley; among these are Little and Big Cottonwood Creeks, Mill Creek, Parley's Creek, Emigration Creek and City Creek. There are other streams too numerous to mention here, but some flow through open channels while sections of others are piped underground. While development is challenged by the floodplain it is also attracted to it.

### **Wetlands**

Wetlands are those areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to normally support a prevalence of vegetation typically adapted for life in saturated soil conditions. The greatest and most significant complex of wetlands in the intermountain area can be found adjacent to and surrounding the Great Salt Lake. These wetlands provide important habitat to resident wildlife and internationally significant habitat, to as many as one million migratory shorebirds and waterfowl make annual migrations across North America. A majority of these wetlands are found on the east side of the lake. The east side of the lake is where the lake receives most of the fresh water and also where the development pressures occur. There are numerous rivers and streams, which flow to the lake which supply this area with the fresh water needed to support wetlands plant and animal life. Wetlands can also be found adjacent to the streams, particularly in areas where the streams flow through relatively flat topography or low-lying areas.

Wetlands can be categorized according to their quality and type. Jurisdictional wetlands are those wetlands that are within the extent of the Corps of Engineers (COE) regulatory overview. For an area to be identified as a jurisdictional wetland, the area must exhibit positive indicators of wetland hydrology, hydrophytic vegetation and hydric soils. If wetlands provide a particularly rich habitat for a variety of wildlife species, it is usually considered to be of high quality, or have a high functional value. Also, wetlands can be classified according to their type. This would include types such as marsh, wet meadow, riparian scrub, playa/mudflat, and open water.

### **Farmlands**

Over the years, much of the farmland in the urbanized area has been developed. Morgan and Tooele counties still maintain a good percentage of their land to agriculture. The remaining farmlands where crops are being produced are located in the western portion of Weber County, and to a lesser degree in western portions of Davis County, between I-15 and the lake, and the Salt Lake Valley. There is a limited amount of Prime/Unique Farmland and Farmland of Statewide Importance in western Weber County, northern Davis County, and western Salt Lake Valley. Historically, development followed farmland in an agrarian economy.

Farmlands of Statewide Importance are not as good as Prime Farmlands, but are nevertheless important to the agricultural base of the area. These farmlands have more limitations than Prime Farmlands, such as steeper slope, high water table, and alkali problems. However, these lands can be made just as productive as the Prime Farmlands with proper management of the land. If farmlands of the type described above are located within incorporated city limits, it is presumed they will be eventually developed into urban type

land uses. Currently, a majority of the acreage of these farmlands is being used to grow winter (dry farm) wheat and alfalfa.

### **Slopes and Faults**

The steep slopes of the Wasatch Mountain Range were created by the Wasatch Fault, which runs the entire length of the urbanized areas. The Wasatch Fault and other faults in the area highlight the potential for earthquakes in the area and the need to consider their possible impact on transportation facilities. As development continues to creep higher on the foothills of the Wasatch Mountains, slope stability, erosion and drainage problems will present engineering challenges in designing transportation facilities. Development is usually attracted more to the views of slopes and faults than repelled by the higher risk of soil instability.

### **Open Space**

Open Space is a large influence to residential and commercial development. Generally, people are attracted to open space. The Wasatch Front Region is surrounded by relatively vast amounts of open space. Currently, in Morgan County large amounts of land are privately held open space, and in Tooele County large amounts of land are owned by the federal government. The urbanized area is fortunate to have exceptional public open space in the mountains to the east and to the west of the valleys. Most of the open space to the east of the Wasatch Front Urban Area is part of the Wasatch National Forest, which is administered by the Forest Service. The Bureau of Land Management primarily administers the open space to the west, found mostly in the Oquirrh Mountains. Some of the most notable peaks in the National Forest in the Wasatch Range just east of the Ogden/Layton area are Ben Lomond Peak, Mount Ogden, Thurston Peak, and Francis Peak. In the Salt Lake area they are Lone Peak, Broadfork Twin Peak, and Mt. Olympus. Numerous nationally recognized winter and summer recreation areas for skiers, hikers and rock climbers are in close proximity. As a consequence, hundreds of thousands of people visit the public lands in the foothills and mountains of the Wasatch, annually. Less notable and frequented are the mountains to the west of the urbanized areas, such as the Oquirrh Mountains that divide Salt Lake and Tooele Counties. There are several natural streams emanating from these mountains as well as canyons that are mostly frequented by people living nearby. The majority of the Oquirrh Mountains is owned by Kennecott Copper Corporation, and is not generally available to the public for open space use.

Other open space features in the area are the Jordan River Parkway, which runs along almost the entire length of the Jordan River in Salt Lake County, the Great Salt Lake and associated shorelines, Antelope Island in the Great Salt Lake in Davis County, and the Farmington Bay Bird Refuge, which is a fresh water bay created by a dike of the Great Salt Lake. Over the past several years, population growth in the urbanized areas has impacted the open space resources of the Wasatch Range in a variety of ways. Two of these ways are mentioned here. First, there are many more people visiting the popular places in the adjacent mountains. This has jeopardized the environmental quality of the mountains by degrading surface and ground water quality. The Wasatch Range is a major source of water for the adjacent urbanized areas, and water quality degradation can have far-reaching effects. Secondly, many access points or trail heads to the canyon and other mountain destinations located on public lands that were commonly used in the past have been closed off to the public by private developments. The effect of this is that much of the public open space becomes inaccessible and the opportunity to visit these popular places becomes lost. Remaining access to non-private lands is channeled through an ever-decreasing number of public access points.

Not only can open space resources be found in the mountains of the Wasatch, but private and public open space is also found in the valleys in the form of farms, developed and natural parks, golf courses, water features, vacant land, and the like. In many instances, these resources may receive more intensive use than those found in the adjacent mountains. Recently, because of the rapid growth in the area, people in general, and state and local political leaders, have become concerned about the relatively rapid loss of private open space resources, such as farmland and vacant land. Urban growth has put considerable pressure on the farmlands that can still be found in, or adjacent to, the urbanized areas. Some individuals and lawmakers value farmlands and would like to see some of them preserved for future generations. Management and development of open space has many questions – How, where, and to what degree will these lands be preserved?

Some agricultural lands are receiving state designation as farmland preserves through the use of conservation easements and favorable tax treatments. These designations assist farmers in preserving their lands for future agricultural use and provide aesthetically pleasing open space today. However, as development pressure and property values increase, it may become increasingly difficult to keep many agricultural lands in agriculture and agricultural preserves. Policy decisions relative to open space will affect land use and development patterns, and, as a consequence, will also affect long range plans for the region's transportation systems.

### **Hazardous Waste Sites**

Currently there are numerous hazardous waste sites, or contaminant sources, located within the urbanized areas. Many of these sources are in relatively close proximity to the transportation projects. Construction through potential contaminant sources may add health and safety concerns and affect construction budget expenditures. The impact of these sites on transportation facilities will need to be addressed during the design and construction phase of each highway or transit project.

There are potentially five types of contaminant sources: Underground Storage Tanks; Title 3 Sites; Toxic Release Inventory 1990 Sites; Resource Conservation and Recovery Act (RCRA) Sites; and Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Sites. The Comprehensive Environmental Response, Compensation and Liability Inventory System (CERCLIS) database documents hazardous waste sites where a release or potential threatened release has been investigated. These sites are further defined as a location that has been reported to the Environmental Protection Agency, and where it is probable that some environmentally hazardous materials are present. Also, the State of Utah Division of Solid and Hazardous Waste maintains databases for underground storage Tank Facilities, Leaking Underground Storage Tank sites, and RCRA facilities.

### **Sensitive Species**

Sensitive species are plants and animals, which are considered, threatened or endangered relative to extinction. There are currently 21 species in the Wasatch Front Urban Area that fall into the sensitive species category. The most notable of these are the peregrine falcon, bald eagle, and Ute ladies tresses, which are all on the federal list of endangered and threatened species. Both peregrine falcon and bald eagle sightings have been reported over the past few years on a fairly regular basis. Some examples of other less notable sensitive species, which are known to inhabit certain areas of the Wasatch Front region, include the spotted frog, least chub, western burrowing owl, ferruginous hawk, white faced ibis, Bonneville cutthroat trout, pocket gopher and others. The likelihood of these and other sensitive species being present in the region will depend on whether or not suitable habitats exist.

### **Ground Water**

Much of the water flowing in streams and interfluvial areas seeps into the ground. The foothills and the base of the mountains are the locations where much of this water seeps into the ground. These locations are referred to as aquifer recharge areas. The water is stored in aquifers of various types. A considerable amount of the Wasatch Front Region's water resources comes from these aquifers, which can be tapped through wells or natural artesian springs. The Salt Lake International Airport receives only about 15 inches of precipitation a year, yet the benches and ski areas can receive 60 to 100 inches of precipitation a year. This contrast in precipitation can be a challenge in determining best development. Past and present human activities have affected these ground water resources in certain locations. If precautions are not taken, harmful materials found in landfills and mine tailings can be leached by rain and snow and find their way into the ground water resources. One example of this situation includes the leaching of heavy metals from the Kennecott Mine tailings, which has contaminated the ground water supply of southwestern Salt Lake County. Another example is the plume of contaminated groundwater that is slowly moving westward near the City of Sunset, caused by the inappropriate disposal of solvents and other chemicals at Hill Air Force Base.

### **Historical Development Layout**

Historically, development has occurred according to the "Plat of Zion." Many of the areas along the Wasatch Front have street layouts based on the "Plat of Zion", implemented by Brigham Young when the Mormon Pioneers permanently settled the area beginning in 1847. This concept is based on a grid of 10-acre

blocks with wide streets. While the concept is apparent in central city areas, the suburbs deviate. Historically, the street network and connecting highways served the local areas. Intercity travel was via the Bamberger Railroad, which ran passenger service from Salt Lake City to Ogden from 1891 to 1952. In the 1950's, the federal government instituted the Interstate Highway System. Interstate 15 linked Salt Lake City, Ogden, and Provo together with points north and south while Interstate 80 linked the area with points east and west.

Historically, development has also followed along Interstate 15, Highway 89, and major collectors. The recently reconstructed 17-mile segment of I-15 through Salt Lake County forms the backbone of the north-south highway system through the Salt Lake Urbanized Area. Other major north-south facilities in Salt Lake County include Redwood Road, Bangerter Highway, State Street, 700 East, and 1300 East. Interstate 215 forms a three-quarter belt around Salt Lake County. Interstate 15 continues north through Davis and Weber Counties and joins Interstate 84 in Weber County. The other major north-south facility in Davis County is U.S. Highway 89. The historic development as followed the geographic constraints particularly in transportation.

### **Transportation**

Large employment centers, such as Hill Air Force Base, the University of Utah, the Salt Lake City International Airport, and the downtown Central Business District will need to be served with an improved transportation system.

The growth and distribution of population and employment in the Wasatch Front Urban Area will have a significant impact on the transportation demands in the year 2030. Transportation accessibility is one of the major, if not the most important factor, where people live and work. To a large extent, people will live and work where transportation exists. Future development patterns will influence and be influenced by transportation. It is better planning to first conceptually plan the major transportation.

While a majority of the population growth is expected to occur in western and southwestern sections of Salt Lake, Davis, and Weber Counties, Salt Lake City will remain the dominant employment center in the Wasatch Front Urban Area. Anticipated growth will increase the need for north-south travel in the area, which is being addressed in part by the recently reconstructed I-15 and the completion of the north-south portion of the Utah Transit Authority's TRAX light rail transit system. In addition, the Salt Lake Urbanized Area's transportation system will need to serve the growing employment centers in suburban locations by addressing the east-west transportation demands and access to north-south freeways. Finally, travel in the Salt Lake Urbanized Area will increasingly be affected by the population and employment growth in the Ogden/Layton Urbanized Area to the north, the Provo/Orem Urbanized Area to the south, Summit County to the east and Tooele County to the west.

Air quality is an influence on transportation. Greater awareness and concern for the air quality has resulted in tighter air quality standards and decreased transportation emissions.

As the entire Wasatch Front Urban Area continues to grow, the interrelationships among development and transportation will continue to increase. These interrelationships have significant impact on the transportation facilities now and in the future. The Ogden/Layton Area's transportation system will need to develop east and west to serve employment centers in suburban locations, such as Clearfield City's Freeport Center. Travel demand will continue to grow in direct proportion to projected population increases. The population and employment growth in Davis and Salt Lake Counties to the south and, to a lesser extent, Morgan County to the east and Box Elder County to the north, will increasingly affect travel demand in the Ogden/Layton Urbanized Area.

The growth and distribution of the Wasatch Front population and employment will continue to have a significant impact on the transportation needs of the future. Increases in regional population and employment translate into a growing demand for travel. In addition, the number of miles driven continues to increase. The amount and distribution of growth provide insights into the type, size and location of new transportation facilities required to meet present and future travel demand, including new highway projects, transit improvements, and transportation facilities for bicycles and pedestrians.

### **Household Size**

Even with relatively large families, Utah is following the national downward trend in household size. As the population ages, birthrates fall and the household size decreases. There are areas in the region that will experience a slowing of population growth due to falling household sizes, while others will increase due to neighborhood recycling, where young families with children move into a neighborhood as the aging population dies. Examples of these phenomena are found in the 2000 Census. Sandy City's household size declined while Ogden's and Salt Lake City's increased due to changing demographics. Certain areas of the region will remain undeveloped into the future even with projected high growth.

### **Technology**

As technology develops its influence on community development touches every aspect dramatically. Technological influences are massive. This report will only very briefly mention a few. For instance, technology advances in communications have reduced the benefit of commuting to work; the design of light rail has changed where people live and work; advances in agriculture have allowed us to eat with less land; and technological advances allow us to live on previously hazardous natural and manmade sites.

### **Reclamation of Industrial Land**

Many of public and private lands will remain undeveloped because of specific environmental constraints, such as steep slopes, prime wetlands, or hazardous substances, but other environmentally challenging properties are now developable due to advances in technology. Some areas currently being used for industrial or mining activity are planned to be reclaimed for other uses. For example, Kennecott Utah Copper Corporation is planning a 12,000-unit, mixed use development on 4,500 acres that it owns in South Jordan.

### **Employment Trends**

In the past 30 years, the region's economy has diversified resulting in more wide spread development. The region's economy was once heavily dependent on a limited number of industrial sectors, primarily mining (Kennecott Utah Copper Corporation) and government/military (Hill Air Force Base, Internal Revenue Service). No longer dependent on a limited number of sectors, the economy is now based on the service sector and other industries, such as health care, education, and local government. Agricultural industries continue to decline in importance on a regional scale. The distribution of commercial and industrial development will remain much as it is today. Much of the region experienced minimal employment change, up or down, during the past decade. The overall pattern shows that large employment gains are occurring in the suburban areas.

### **Public Policy**

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. Projections for the Wasatch Urban Area Long Range Transportation Plan: 2002-2030 is based on individual city and county land use assumptions. A majority of the region is expected to be developed for residential uses. These local master plans call for relatively low-density residential and non-residential development patterns, with some pockets of denser activity. Large areas of industrial/warehouse development are planned in western Salt Lake City, along the I-15 corridor, and around Hill Air Force Base. High-density office and commercial developments are focused mainly in the Salt Lake and Ogden central business districts, with smaller commercial areas located in southern Salt Lake County, northern Davis County, and southern Weber County. Additional, smaller nodes of commercial and retail development are dispersed throughout urban and rural portions of Salt Lake, Davis, and Weber Counties.

The Utah Quality Growth Act of 1999 created the Utah Quality Growth Commission to address the challenges and opportunities that growth brings to Utah. In addition, several public and private partnership planning efforts involved in smart growth initiatives have developed land use alternatives and growth scenarios. Envision Utah's outreach presentations provided local public officials and the general public the opportunity to examine the future consequences of various land use decisions. The growth scenarios ranged from the status quo land use planning to a demonstration of much greater density. These planning exercises and demonstrations proved beneficial in educating participants on development options and their anticipated consequences.

A significant portion of Salt Lake, Davis, and Weber Counties is currently zoned for low-density residential development. Some higher densities are allowed in eastern Salt Lake City, while the southeast and southwest areas of Salt Lake County are zoned for lower housing densities. Industrial land uses are planned for west Salt Lake City, along the I-15 corridor, northern West Valley City, the western portion of North Salt Lake, and the west side of Salt Lake County. Areas for commercial land uses include concentrations in Salt Lake City's central business district and along primary transportation corridors including I-15, I-215, State Street, 400 South, Highland Drive, 3500 South, 4500 South and 7200 South. Additional commercial land use nodes are dispersed throughout Salt Lake County and southern Davis County to serve adjoining residential communities. An extension of the existing transportation network will provide needed highway and transit service to newly developed land. As land use changes, so will the type and size of facilities needed to meet increased travel demand.

Future land use characteristics of the Ogden/Layton Urbanized Area will play a key role in determining future development trends. Large portions of western Weber and North Davis Counties are currently zoned for low-density residential development. Some higher density housing is being built in Ogden City's Canyon Road Community. Industrial land uses are located at the redeveloped Business Depot Ogden (the former Ogden Defense Depot), Hill Air Force Base, the Ogden City Industrial Park and Clearfield's Freeport Center. Areas for commercial land uses include linear concentrations along major arterial roads including Riverdale Road, the southeastern portion of Harrison Blvd., 12th Street between Washington Blvd. and I-15, Hill Field Road near the Layton Hills Mall, State Street (Layton and Clearfield) and Main Street (Kaysville, Clearfield and Sunset). The McKay-Dee Hospital has moved to a new 62-acre location on Glassman Way. Additional commercial nodes are dispersed throughout the Ogden/Layton Urbanized Area to serve adjoining residential communities.

Public Policy is the greatest contributing factor in development. This report has briefly mentioned the general development trends in the region and in each county and the contributing and limiting influences on development. Ultimately, the many development constraints and influences are measured, weighed, compared, and balanced in public policy.

Development public policy is articulated in Master (sometimes referred to as General) Plans, Land Use Management Codes, and other planning documents. Master Plans and Land Use Management Codes are formally adopted whereas other planning documents may not receive formal adoption. All region counties continue to update their Master Plans and Land Use Management Codes. The counties have cooperated in producing the Wasatch Front Regional Open Space Plan; this plan gives each county guideline for preserving and developing open space. The urban counties in the region (Davis, Salt Lake, and Weber) have been supportive of Envision Utah. Envision Utah is partially State supported to advocate smart growth. Envision Utah defines "smart growth" as growth that requires minimal infrastructure and maximizes environmental and human benefits.

## **Part V. Capabilities Assessment**

Within the WFRC, local governments have a diverse and strong capability to accomplish hazard mitigation; yet, enough similarity exists between each of the jurisdictions that this capabilities assessment could be completed for all five counties. General capabilities of the region and for each jurisdiction are addressed then any specific city and county capabilities are mentioned. This assessment analyzes current capacity to mitigate the effects of natural hazards and emphasizes the positive capabilities that should be continued.

The following areas were assessed to determine mitigation capabilities:

1. Staff and Organizational
2. Technical
3. Fiscal
4. Policies and Programs
5. Legal Authority
6. Political Willpower

### **1. Staff and Organizational**

The assessment found that each county, along with most of the large incorporated cities, within the WFRC region have extensive capabilities to accomplish mitigation. Most counties and cities are already protecting their citizens from natural hazards under one if not several departments within their government structure.

#### City and County Elected Officials

An elected council or a commission consisting between three or seven members governs each county. Either a town or city council, consisting between five or seven members, governs each municipality. The elected officials have the responsibility of making mitigation policies. All cities and counties receive their legal authority to govern from the State of Utah.

#### County General Capabilities

Listed below is a general organizational list of county governmental administrative divisions that perform pre-disaster mitigation:

- Elected officials
- City Managers
- County and City Attorneys
- County Assessors
- County Clerks
- Human Services/Personnel Directors
- County and City Treasurers/ Finance.
- Public Works
- County Health

#### Emergency Management

All counties and most of the larger incorporated cities have two state owned Universities that have designated emergency management directors. The emergency management office is responsible for natural and man-made hazard mitigation, preparedness, response, and recovery operations.

#### Local Emergency Planning Committee (LEPC)

The mission of LEPC is to coordinate emergency preparedness between all public and private emergency task disciplines. At a minimum, the LEPC consists of -- elected state and local officials; law enforcement, civil defense, firefighting, first aid, health, local environmental, hospital, and transportation personnel; broadcast and print media; community groups; and owners and operators of facilities that are required by federal law to have emergency planning. Each county in the region has a LEPC.

### Fire Service

Most cities staff fire service organizations, and all five counties have fire service. In some cases a fire district rather than a county fire department provides the fire service.

### Public Works

Divisions within public works often include; streets, engineering, water, power, wastewater, and sanitation. The public works departments within the counties and larger cities are very sophisticated and currently account for much of the mitigation already taking place within the Wasatch Front region. Several public works departments have storm water management sections and watershed management departments.

### Health Care

The region's hospitals and county health departments provide medical emergency preparedness and response. The region's county health departments organize, coordinate, and direct emergency medical and health services. The health departments assess health hazards caused by damage to sewer, water, food supplies or other environmental systems. They also provide safety information, assess disaster related mental health needs and services, and provide crisis counseling for emergency workers. For the most part, the health departments within the five counties are adequately staffed, trained, and funded to accomplish their missions.

## **2. Technical Capability**

Counties making up WFRC have an advanced technical capability to implement hazard mitigation strategies.

### Technical Expertise

Most of the counties and large incorporated cities within the WFRC have full-time planners, emergency managers, building inspectors, housing specialists, and engineers on staff. Salt Lake County also employs a part-time geologist.

### Geographic Information Systems (GIS)

Staff experience with GIS varies widely between the large resources of Salt Lake, Davis, and Weber counties, and the relatively small resources of Morgan and Tooele counties. All counties in the region have at least some staff to coordinates data processing and computer capabilities for GIS. GIS is a tremendous geo-referenced set of hardware and software tools that are used to collect, manage, and analyze spatial data. (GIS capabilities are often found in other departments such as public works or information technology.) GIS is most beneficial when data from all departments and planning jurisdictions is inputted for analysis.

### Public Safety Communications (PSC)

Public safety communications assures emergency communications through radio, microwave, telephone, satellite, internet, e-mail, intercom, fax, and amateur radio. One of the most beneficial capabilities of PSC is providing cross communication between equipment and bands. PSC coordinates dissemination of emergency information to the media, the public, and emergency personnel; activates internal information systems; acts as a liaison to congressional and legislative elected officials; assists in the provision of emergency information and documentation of emergencies' impacts.

### Public Works

Public works departments usually involve the division capabilities of engineering – transportation, GIS; sometimes power; streets; water; wastewater; and sanitation. As a team, public works employees identify critical infrastructure and plan and prepare for emergency mitigation.

## **Other Technical Capabilities**

### Utah State Division of Emergency Services and Homeland Security (Utah DESHS)

Utah DESHS assists local governments in preparing for and responding to emergencies. The division serves as the liaison between local, state, and federal emergency assistance. The division educates the

public about earthquakes, hazardous materials, floods, communications, leadership, information technology, funding, coordination and supplies.

#### Utah State University Cooperative Extension

The extension's mission is to facilitate individuals, families, and communities in putting research-based knowledge to work. Many of the programs and informational courses improve pre-disaster mitigation.

#### University of Utah

The University of Utah is Utah's flagship state run higher education institution. The University is a technical resource of faculty, mitigation commissions, and internship opportunities.

#### Wasatch Front Regional Council (WFRC)

The Wasatch Front Regional Council is a valuable cooperative organization between Davis, Morgan, Salt Lake, Tooele, and Weber counties to facilitate pre-disaster mitigation among many other things. The WFRC is a resource for coordination, communication, and planning expertise.

### **3. Fiscal Capability**

All counties have limited fiscal capabilities to implement mitigation actions. The counties of Davis, Salt Lake, Tooele, and Weber have a larger tax base and greater man-made hazards than Morgan County thus allowing for more mitigation to be accomplished. When compared to the state, the budgeted expenditures of Salt Lake, Davis and Weber counties are in the top five, Tooele is at the top of the middle third, and Morgan is near the mid-point of the middle third. It is likely that each county can supply the local fiscal match for existing federal mitigation programs. Each county and most of the cities within WFRC have provided matching funding for federal grants in the past.

Utah classifies counties into five categories according to the Utah State Legislature; Section 17-50-501 update 2003, each County is classified according to its population. Class 1- over 700, 000, Class 2- 125,000-700,000, Class 3- 18,000-125,000, Class 4- 10,000-18,000, Class 5- 3,500-10,000, Class 6- under 3,500.

County	Population	Class
Davis	238,994	2
Morgan	7,129	5
Salt Lake	898,387	1
Tooele	40,735	3
Weber	196,533	2

The State of Utah grants graduated autonomy according to class size. The lower numbered class counties and cities receive more authority from the State to regulate their own affairs.

### **4. Policies and Programs**

This part of the assessment includes the identification and evaluation of existing plans, policies, programs, ordinances, or activities that either increase or decrease vulnerability to natural hazards. Positive activities, which decrease hazard vulnerability, should be sustained and enhanced if possible. Negative activities, which increase hazard vulnerability, should become targeted for reconsideration and thoroughly addressed within the mitigation actions portion of this plan.

#### County Ordinances

All five counties have adopted several plans and ordinances that are relevant to the Pre-Disaster Mitigation Plan.

#### Plans

Each county has a comprehensive land use plan, capital improvement plan, and an emergency operations plan. Most of the large cities also have these plans as well as economic development and community master plans.

The following tables should show areas where pre-disaster mitigation planning can be strengthened through additional plans and ordinances. Often, one plan or ordinance contains language and authority for multiple plans and/or ordinances. For example, in Morgan County, the Morgan County Subdivision Ordinance explains in detail sensitive soils, historic preservation, and drainage. Within the land use planning and subdivision portions of some general plans items such as stream maintenance, erosion, and natural hazards are addressed, but they do not have their distinct separate plan or ordinance (Tables 5-1, 5-2, 5-3, 5-4, 5-5).

**Table 5-1 Davis County**

Davis County	Bountiful	Centerville	Clearfield	Clinton	Farmington	Fruit Heights	Kaysville	Layton	North Salt Lake	South Weber	Syracuse	West Bountiful	Woods Cross	Unincorporated
<b>Plans</b>														
Comprehensive	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stormwater Management	Y				Y			Y						Y
Flood Assistance														Y
Capital Improvements	Y							Y						N
Land-Use/General	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Community Rating System	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Emergency Management	Y	Y	Y	Y										Y
Economic Dev.	Y							Y						N
<b>Ordinances</b>														
Zoning	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Subdivision	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Historic Preservation														
Building Code	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Floodplain Management														Y
Drainage														Y
Storm Water														Y
Stream Maintenance														Y
Erosion Control														
Natural Hazards														

**Table 5-2 Morgan County**

Regulatory Tools (Ordinances, Codes, Plans)	Local Authority (Y/N)	Does State Prohibit (Y/N)	Higher Level Jurisdiction Authority (Y/N)
Building Code	Y	Y	Y
Zoning Ordinances	Y	N	Y
Subdivision Ordinances or Regulations	Y	N	Y
Special Purpose Ordinances (Floodplain Management, Stormwater Management, Hillside or Steep Slope Ordinances, Wildfire Ordinances, Hazard Setback Requirements)	N	N	N
Growth Management Ordinances/ Smart Growth/ Anti-Sprawl Programs	N	N	N
Site Plan Review Requirements		N	

Master/ General/ Comprehensive Plan	Y	N	Y
Capital Improvements Plan	Y	N	N
Economic Development Plan		N	
Emergency Operations Plan	Y	N	Y
Post-Disaster Recovery Plan	Y	N	Y
Post-Disaster Recovery Ordinance	N	N	N
Real Estate Disclosure Requirements	N		N

**Table 5-3 Salt Lake County**

<b>Regulatory Tools (Ordinances, Codes, Plans)</b>	<b>Local Authority (Y/N)</b>	<b>Does State Prohibit (Y/N)</b>	<b>Higher Level Jurisdiction Authority (Y/N)</b>
Building Code	Y	Y	Y
Zoning Ordinances	Y	N	N
Subdivision Ordinances or Regulations	Y	N	N
Special Purpose Ordinances (Floodplain Management, Stormwater Management, Hillside or Steep Slope Ordinances, Wildfire Ordinances, Hazard Setback Requirements)	Y	N	N
Growth Management Ordinances/ Smart Growth/ Anti-Sprawl Programs	Y	N	N
Site Plan Review Requirements	Y	N	
Master/ General/ Comprehensive Plan	Y	N	Y
Capital Improvements Plan	Y	N	Y
Economic Development Plan	Y	N	N
Emergency Operations Plan	Y	N	N
Post-Disaster Recovery Plan	Y	N	N
Post-Disaster Recovery Ordinance	Y	N	Y
Real Estate Disclosure Requirements	Y/N		Y/N

**Table 5-4 Tooele County**

<b>Regulatory Tools (Ordinances, Codes, Plans)</b>	<b>Local Authority (Y/N)</b>	<b>Does State Prohibit (Y/N)</b>	<b>Higher Level Jurisdiction Authority (Y/N)</b>
Building Code	Y	Y	Y
Zoning Ordinances	Y	N	N
Subdivision Ordinances or Regulations	Y	N	N
Special Purpose Ordinances (Floodplain Management, Stormwater Management, Hillside or Steep Slope Ordinances, Wildfire Ordinances, Hazard Setback Requirements)	Y	N	N
Growth Management Ordinances/ Smart Growth/ Anti-Sprawl Programs	Y	N	N
Site Plan Review Requirements	Y	N	
Master/ General/ Comprehensive Plan	Y	N	Y
Capital Improvements Plan	Y	N	Y
Economic Development Plan	N	N	N
Emergency Operations Plan	Y	N	N
Post-Disaster Recovery Plan	Y	N	N
Post-Disaster Recovery Ordinance	Y	N	Y
Real Estate Disclosure Requirements	N		Y/N

**Table 5-5 Weber County**

	Farr West	Harrisville	Hooper	Huntsville	Marriott-Slaterville	North Ogden	Ogden	Plain City	Pleasant View	Riverdale	Roy	South Ogden	Uintah	Washington Terrace	West Haven	Un-incorporated
<b>Plans</b>																
Comprehensive						Y	Y					Y				Y
Stormwater Management-Public Works Dept.						Y	N		Y	Y	Y	Y				Y
Flood Mitigation Assistance						N					N	N				Y
Capital Improvement						Y	Y			Y	Y	Y				Y
Land-Use/General				Y		Y	Y		Y	Y	Y	Y				Y
Community Rating System																Y
Emergency Management						Y	Y		Y	Y	Y	Y				Y
<b>Ordinances</b>																
Zoning				Y		Y	Y		Y	Y	Y	Y				Y
Subdivision				Y		Y	Y		Y	Y	Y	Y				Y
Historical Preservation Ordinance						N	Y		Y		N	N				Y
Building Code-				Y		Y	Y		Y	Y	Y	Y				Y
Floodplain Management						Y	Y			Y	Y	Y				Y
Drainage Ordinance-State Requirements						Y	Y		Y	Y	Y	Y				Y
Storm Water Management						Y	Y		Y	Y	Y	Y				Y
Stream Maintenance							Y			Y	Y					Y
Erosion Control						Y			Y	Y	N	Y				Y
Natural Hazards						N	Y		Y		N					Y
Other					Y	Y	Y		Y	Y						Y

### General Plan

The Utah Code Annotated (UCA) has set forth that "Each municipality shall prepare and adopt a comprehensive, long-range general plan for present and future needs of the municipality; growth and development of the land within the municipality or any part of the municipality" (UCA 10-9-301(1) (1997)). "The planning commission shall make and recommend to [city commission] a proposed general plan for the area within the municipality" (UCA 10-9-302(1)(a) (1997)). These plans serve as a guide for decision-making on rezoning and other planning proposals and as the goals and policies of municipalities attempting to guide land use in local jurisdictions. Each plan is recommended to include land use, transportation, environment, public service and facilities, rehabilitation, redevelopment, conservation, and economics. Also recommended are implementing recommendations including the use of zoning ordinances, subdivision ordinances, capital improvement plans, and other suitable actions that the municipality deems appropriate. General plans articulate the jurisdiction's vision and land use management codes implement that vision. General plans and land use management codes are being consulted, reviewed, and changed as necessary.

### Emergency Operations Plan (EOP)

Emergency operation plans pre-determine actions to be taken by government agencies and private organizations in response to an emergency or disaster event. An EOP describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster.

Most county's EOP were adopted in the early ninety's and are being or have been revised since then. Many plans have a section specific to hazard identification and analysis along with a damage assessment and debris removal section.

The EOP identifies specific operations to be undertaken by the county to protect lives and property immediately before, during, and following an emergency. EOP were reviewed prior to writing this plan.

### Building Codes

International and national building codes have been adopted by all jurisdictions in the region. These codes are constantly in review for reasonable preparedness for disasters. Locally, building officials lobby for additions or exceptions to international and/or national building codes according to local conditions. Most insurance policies rely on the international and national building code standards for assurance.

The Insurance Services Office, Inc performs Building Code Effectiveness Grading Reports (BCEGS). The program implemented in 1995 assesses the building codes in effect in a particular community and how well the community enforces its building codes. The BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with one showing exemplary commitment to building code enforcement. Insurance Services Inc. (ISO) developed advisory rating credits that apply to ranges of BCEGS classifications 1-3, 4-7, 8-9, 10. ISO gives insurers BCEGS classifications, BCEGS advisory Credits, and related underwriting information. The concept is that communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. FEMA also uses these scores in their competitive grant programs giving a higher ranking to those projects with lower scores. The following table highlights the BCEGS scores for Wasatch Front Region jurisdictions (Table 5-6).

**Table 5-6 Building Code Effectiveness Grading Reports**

Community	County	BCEGS Classification		Date
		Residential	Commercial	
Bluffdale	Salt Lake	3	3	2002
Bountiful	Davis	3	3	2001
Centerville	Davis	3	3	1999

Clearfield	Davis	5	5	1999
Clinton	Davis	5	5	2000
Davis County	Davis	5	5	2001
Draper	Salt Lake	4	4	2000
Farmington	Davis	5	5	2000
Farr West	Weber	4	4	2002
Fruit Heights	Davis	5	5	2001
Grantsville	Tooele	99	99	1999
Huntsville	Weber	3	3	2003
Kaysville	Davis	5	5	1999
Layton	Davis	4	4	1999
Marriott-Slaterville	Weber	3	3	2001
Midvale	Salt Lake	4	4	1999
Morgan	Morgan	3	3	2002
Morgan County	Morgan	4	4	2001
Murray	Salt Lake	2	2	2000
North Ogden	Weber	4	4	1999
North Salt Lake	Salt Lake	4	4	1997
Ogden	Weber	3	3	1999
Plain City	Weber	5	5	2003
Riverton	Salt Lake	5	5	2000
Roy	Weber	4	4	2000
South Jordan	Salt Lake	5	5	1999
South Ogden	Weber	3	3	2000
South Salt Lake	Salt Lake	3	3	2002
South Weber	Davis	4	4	1998
Salt Lake City	Salt Lake	3	3	2002
Salt Lake County	Salt Lake	4	4	1998
Sandy	Salt Lake	3	3	1999
Stockton	Tooele	99	99	1999
Syracuse	Davis	4	4	1999
Taylorsville	Salt Lake	4	4	1998
Tooele	Tooele	3	3	2003
Tooele County	Tooele	2	2	2003
Uintah	Weber	3	3	2003
West Bountiful	Davis	99	99	1999
West Jordan	Salt Lake	3	3	2000
West Point	Davis	6	6	1998
West Valley City	Salt Lake	4	4	1999
Washington Terrace	Weber	3	3	1999
Weber County	Weber	5	5	2000
Wendover	Tooele	3	3	1997
Woods Cross	Davis	99	99	2002

#### Zoning Ordinances

Zoning ordinances usually follow closely the recommendations of nature. Zoning ordinances designate the use of land and structures for the purpose of protecting the health, safety, and welfare of the jurisdiction's

residents and businesses. A zoning ordinance divides all land within a jurisdiction into zones or related uses. The zoning ordinance is comprised of two parts, the text and the zoning map. Specific zones are usually created for residential, commercial, industrial, and government uses. The map defines the boundaries of these zones and the text provides the regulations for the various uses that are permitted to exist in each of the zones.

#### Subdivision Ordinance

These ordinances regulate all divisions and improvements of property. Included in this ordinance is the division of land involving the dedications of new streets and roads or a change in existing streets/ roads.

The subdivision ordinance along with the “Flood Damage Prevention Ordinance” prevents flood losses and minimizes the adverse effects that development will have on stormwater drainage through impervious surface requirements, sedimentation, and erosion control. Subdivision ordinances designate the treatment of sensitive soils, emergency access, wildlife considerations, etc.

#### Floodplain Ordinances

These ordinances prevent building in special flood hazard areas and provide flood loss reduction measures to new and existing development. Floodplain management ordinances help to provide insurance to home and business owners through the National Flood Insurance Program.

#### Community Ranking System

Communities that regulate development in floodplain are able to participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally backed flood insurance policies available for properties in the community. The Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. There are ten CRS classes. Class 1 requires the most credit points and gives the largest premium reduction. Class 10 receives no premium reduction. Refer to Table 5-7 for a list of the participating communities.

**Table 5-7 Community Ranking System Scores for WFRC**

<b>Community Name</b>	<b>Entry Date</b>	<b>Effective Date</b>	<b>Class</b>
Bountiful, city of	10/01/91	10/01/91	9
Centerville, city of	05/01/02	05/01/02	9
North Ogden, city of	10/01/93	05/01/03	8
West Bountiful, city of	10/01/96	10/01/96	9

### **5. Legal Authority**

Local governments play an essential role in implementing effective mitigation. Each local government will review all present or potential damages, losses, and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In the counties and cities making up the WFRC the local executive responsible for carrying out plans and policies are the County Commissioners and city or town Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document. The cities and counties of Utah have the authority, through policing, to protect the health, welfare, and safety of their residents.

### **6. Political Willpower**

Officials of the Wasatch Front region have shown support for pre-disaster planning in the following ways:

#### Community Development Documents

Elected officials have adopted updated community development documents to reduce the risk of disasters. Each county and most cities have updated Emergency Operation Plans, Land Use Management Codes, International Building Codes, and General Plans that include pre-disaster planning. In addition residents support the Wasatch Front Regional Council’s recently adopted Wasatch Front Regional Open Space Plan.

In the Wasatch Front Regional Open Space Plan, property with higher probability to disaster is recommended for open space or lower intensity uses.

Emergency Planning Courses

Wasatch Front region residents have supported emergency planning courses sponsored by the State of Utah's Division of Emergency Services and Homeland Security and local governments such as: CERT (Certified Emergency Response Team), LEPC, HAZMAT, Site Plans and Ordinances, Real Estate Requirements, and Hazard Mitigation.

## Part VI. Risk Assessment

### A. Hazard Identification

The first step in risk assessment is identifying the hazards that could affect the Wasatch Front region. Hazard identification addresses the geographic extent and intensity / magnitude of a hazard as well as the probability of its occurrence. Hazard identification was initiated through an extensive process that utilized the following:

- Core Planning Team
- Local Planning Team
- Technical Team
- Community and Public individuals
- Elected Officials
- City and County Agencies
- Utah Department of Emergency Services and Homeland Security
- Utah Geological Survey
- Utah Automated Geographic Reference Center

The natural hazards in the table below have the possibility of affecting each county within the Wasatch Front region. The identification process for each county and participating jurisdictions utilized those natural hazards that consistently affected each county prior to and during the planning process based on history of occurrences, future probability, and risk (Table 6-1). Table 6-1-1 identifies those hazards on a county level for easy reference.

The Wasatch Front Regional Council with the help from local officials, created maps that identified the location of critical facilities and the municipalities affected by each identified hazard. Initial data from this study was also used to determine those hazards that presented the greatest risk to each of the counties. The geographic extent is identified in the maps at the end of every county section. The hazard intensity/ magnitude and probability is also profiled in each county section.

County jurisdiction's contributed to the risk assessment analyses performed for the county when located within an identified hazard boundary (See Section E). Drought and Severe Weather are considered regional hazards and have been profiled as such. Please refer to Annex 1 Regional Hazards for more information.

**Table 6-1 Hazard Identification**

Hazard	How Identified	Why Identified
<b>Mapped Hazards</b>		
Earthquake	<ul style="list-style-type: none"><li>• Review of County Emergency Operations Plans</li><li>• Review of past disaster declarations</li><li>• Input from City and County Emergency Operations Managers, USGS, UGS, Utah DESHS, and community members</li></ul>	<ul style="list-style-type: none"><li>• Utah has a 1/5 chance, of experiencing a large earthquake within the next fifty years.</li><li>• Numerous faults throughout Utah including the Intermountain Seismic Zone.</li><li>• Utah experiences approximately 13 earthquakes a year with a magnitude over 3.0.</li><li>• Can create fire, flooding, hazardous materials incident, transportation, and communication limitations.</li><li>• The Wasatch Front has recorded large earthquakes in the past and is expected to experience a large earthquake in the future.</li><li>• Can create fire, flooding, hazardous materials incident, transportation and communication</li></ul>

		limitations.
Landslide	<ul style="list-style-type: none"> <li>Input from City and County Emergency Operations Managers, USGS, UGS, NCDC, Utah DESHS, and community members</li> </ul>	<ul style="list-style-type: none"> <li>Have caused damage in the past to residential and commercial infrastructure.</li> <li>Can be life threatening.</li> <li>Generally occur in known historical locations, therefore risks exist throughout much of the Wasatch Front.</li> <li>Would like to increase community awareness.</li> </ul>
Wildland Fire	<ul style="list-style-type: none"> <li>Review of County Emergency Operations Plans</li> <li>Review of Community Wildfire Plans</li> <li>Input from County Emergency Managers, Utah DESHS, Utah FFSL, Utah FS, NWS, FEMA, and local community members</li> </ul>	<ul style="list-style-type: none"> <li>Serious threat to life and property.</li> <li>Increasing threat due to urban sprawl in URWIN areas.</li> <li>Secondary threat associated with flooding, drought, and earthquake.</li> <li>Most of Utah is at risk including the growing counties of the Wasatch Front region.</li> <li>Additional funding and resources offered by local and state agencies to reduce risk.</li> <li>Would like to increase community awareness.</li> </ul>
Problem Soils	<ul style="list-style-type: none"> <li>Review of County Emergency Operations Plans</li> <li>Input from community members, Utah, DESHS, and UGS</li> <li>Researched historical data</li> </ul>	<ul style="list-style-type: none"> <li>Related to subsequent effects from earthquakes.</li> <li>Have affected infrastructure and local economy in the past.</li> </ul>
Dam Failure	<ul style="list-style-type: none"> <li>Review of County Emergency Operations Plans</li> <li>Input from community members, Utah DWS, Dam Safety Section, Utah DESHS</li> <li>Review of inundation maps</li> </ul>	<ul style="list-style-type: none"> <li>Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc.</li> <li>Many reservoirs located in the five county region of the Wasatch Front.</li> <li>Threat to downhill communities.</li> <li>Subsequent effects include flooding, fire, and debris flows.</li> <li>Would like to increase community awareness.</li> <li>Would like to incorporate mitigation measures into existing plans to help serve local residents.</li> </ul>
<b>Unmapped Hazards</b>		
Flood/ Flash Flood	<ul style="list-style-type: none"> <li>Review of past disaster declarations</li> <li>Input from City and County Emergency Operations Managers, Utah DWS, UGS, Utah Army Corps of Engineers, Utah DESHS, and community members</li> <li>Review of Flood Insurance Studies,</li> </ul>	<ul style="list-style-type: none"> <li>Several previous incidents have caused severe damage and loss of life.</li> <li>Many of the rivers and streams are located near neighborhoods.</li> <li>Many neighborhoods are located on floodplains, alluvial fans.</li> <li>Due to Utah's geology and climate cloudburst storms and heavy precipitation cause flash flooding throughout most of the Wasatch Front.</li> </ul>

	Floodplain maps, and Flood Insurance Rate Maps	
Drought	<ul style="list-style-type: none"> <li>Review of County Emergency Operations Plans</li> <li>Input from community members, Utah DESHS, NWS, NCC, and NCDC</li> </ul>	<ul style="list-style-type: none"> <li>Affects local economy and residents.</li> <li>Affects water reservoirs levels and therefore culinary, irrigation, and municipal water.</li> <li>Currently in a drought period.</li> <li>Secondary threat associated with wildfire.</li> <li>Utah is the nations second driest state.</li> <li>Can result in loss of life to farming and livestock.</li> </ul>
Infestation	<ul style="list-style-type: none"> <li>Review of County Emergency Operations Plans</li> <li>Input from community members, Utah FFSL, Utah State University Extension Service, Idaho Forest Health Protection Agency, Boise State Foresters, and Utah Dept. of Agriculture</li> </ul>	<ul style="list-style-type: none"> <li>Consistently affects this region.</li> <li>Declined forest health and agriculture losses.</li> <li>Previous experiences have affected the residents of the Wasatch Front.</li> <li>Affects local economy.</li> <li>Destruction can be severe and is very costly to mitigate.</li> <li>Need a better understanding of ways to mitigate and prepare.</li> <li>Secondary threat of drought.</li> </ul>
Severe Weather	<ul style="list-style-type: none"> <li>Review of County Emergency Operations Plans</li> <li>Review of past disaster declarations</li> <li>Input from City and County Emergency Operations Managers, Utah Avalanche, Forecast Center, Utah Department of Transportation, and community members</li> </ul>	<ul style="list-style-type: none"> <li>Damage to communities, homes, infrastructure, roads, ski areas, and people.</li> <li>Can cause property damage and loss of life.</li> <li>Affects local economy and vegetation.</li> <li>Lightning number one death in Utah.</li> <li>Can be costly to recover from.</li> <li>Affects the young and old more severely.</li> </ul>

**Table 6-1-1 County Hazard Identification**

	Davis County	Morgan County	Salt Lake County	Tooele County	Weber County
Earthquake	X	X	X	X	X
Landslide	X		X		X
Wildland Fire	X	X	X	X	X
Problem Soils					
Dam Failure		X	X		X
Flood/ Flash Flood	X	X	X		X

Drought		X	X	X	
Infestation				X	
Severe Weather	X	X	X	X	X

The hazard identification process was aided through the use of FEMA How to Guidance documents, FEMA 386-1,2,3,7 FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12, Disaster Mitigation Act of 2000, 44 CFR Parts 201 and 206, Interim Final Rule, and FEMA Region VIII Crosswalk. The risk assessment process also utilized assistance from local Wasatch Front region GIS departments using the best available data.

## B. Hazard Profile

This section describes the causes and characteristics of each identified hazard including it's severity or magnitude (as it relates to the percentage of the jurisdiction that can be affected), probability, conditions that make the area prone to the hazard, a hazard history, and a map of the hazard's geographic location or extent. The hazards were profiled based on history of occurrence, local input, county emergency operations plan's, and county master or general plans, scientific reports, historical evidence, and hazard analysis plans. A risk assessment "Hazard Profile" table was created that highlights the above-mentioned materials in each of the county portions of the plan introducing each identified hazard.

In determining hazard magnitude a scale was used to identify the level of damage on a countywide basis from Catastrophic to Negligible (Table 6-2).

**Table 6-2 Hazard Profile**

	<b>Jurisdiction Affected</b>	<b>Risk</b>
<b>Catastrophic</b>	More than 50%	Extreme or High
<b>Critical</b>	25-50 %	Moderate
<b>Limited</b>	10-25%	Moderate
<b>Negligible</b>	Less than 10%	Low

The probability of a hazard event was determined through the amount of risk to the county. The probability or likelihood of an occurrence is categorized into four categories: Highly Likely, Likely, Possible, and Unlikely.

The geographical extent or location of the community that would be affected has been identified in the mapping portion of each county when plausible.

Hazard history has been identified and recorded and is located in Section F of each county section.

Maps were created using GIS software to identify the location and extent of each identified hazard area. Drought, Flood, Infestation, and Severe Weather maps were unable to be created due to the lack of data, or the nature and geographic extent of these hazards, therefore, hazard profiles will be in narrative form only.

The following Risk Assessment maps were created for each County:

- Earthquake Epicenters and Fault Zones
- Landslide
- Wildfire
- Dam/ Reservoir Sites

## **C. Vulnerability Analysis**

The vulnerability analysis is based on asset identification and potential loss estimates for those jurisdictions located within identified hazard areas.

### **Asset Identification**

The vulnerability analysis combines the data from each of the hazard profiles and merges it with community asset information to analyze and quantify potential damages from future hazard events. The asset inventory identifies buildings, roads, and critical facilities that can be damaged or affected by the hazard events. Critical facilities are of particular concern because of the essential products and services to the general public they provide. These critical facilities can also fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in this plan include hospitals, police and fire stations, schools, communication facilities, utility companies, water and wastewater treatment plants. In order to assess where and to what extent the identified hazards will affect the assets of each County the locations of assets were identified and intersected with the mapped hazards using GIS software (Appendix D).

### **Potential Loss Estimates**

Potential dollar loss estimates were identified using this same method and therefore estimates were completed for existing infrastructure only. When data permitted, structure, content, and function of the identified vulnerable infrastructure was incorporated into the vulnerability assessments. Describing the vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets.

Future planned development was unable to be analyzed due to the lack of data available in GIS format. However, countywide development trends have been identified and are addressed within Part IV Regional Data.

The core planning team and local planning team members estimated potential losses for the identified hazards by using the methodology explained in the FEMA document Understanding Your Risks: Identifying Hazards and Estimating Losses, Utah DESHS historical data and GIS data.

The information sources used to complete the vulnerability assessment portion of this plan include; Utah DESHS, County GIS departments, County Assessors Office, HAZUS MH data, and the Utah Automated Geographic Reference Center (AGRC). Parcel Data, and Census 2000 data were used to identify household types and numbers as well as the number of residents within the identified hazard boundary. This data was compiled into GIS layers that were used as overlays to identify critical facilities, municipalities, roads, and residents. Utah DOT provided the base map layer to aid in the risk assessment. The assets that have been identified are based on the best available data during the development of this plan in GIS form.

### **Methodology**

Geographic Information System (GIS) software was used as the basic analysis tool to complete the hazard analysis for the WFRC Pre-disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and census 2000 demographic information. In Salt Lake, Davis, and Weber Counties parcel data was used to determine the number and value of residential structures vulnerable to each hazard. Statewide digital data was obtained from Utah Automated Geographic Reference Center (AGRC) for the following hazards; landslides, problem soils, quaternary faults, wildfire, dam locations, and epicenter locations. The vulnerability assessment for each county estimates the number of homes, business, infrastructure and population vulnerable to each hazard and assigns a replacement dollar value to residential structures and infrastructure in each hazard area. The value of residential housing was calculated using estimated average residential housing values for Tooele and Morgan counties, as parcel data was unavailable. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

The methodology used to determine vulnerability for earthquakes, problem soils, landslides and wildfire within the study area was almost identical. The number of households and population vulnerable to each hazard was determined using Block Data from the 2000 Census data, or parcel data where available. The Block Data from the 2000 Census database or parcel data was intersected with each of the mapped hazard layers in order to determine the number and location of residential housing units and population at risk from hazards. The methodology used, assumes an even distribution of residential housing units and population across each census block. Point data from HAZUS MH was used to determine the number of businesses, and the annual sales of each business in each hazard area. Dam failure inundation maps were available for Salt Lake County only. The vulnerability analysis for the Salt Lake County Dam failure was completed in the same manner as described above using GIS, parcel data and 2000 Census block data.

The number of acres of extreme, high, and moderate wildfire, acres of historically active landslides, acres within earthquake fault zones, and acres of problem soils were determined for each city and the unincorporated county. Once an acre total was identified it was overlaid on the Census Block data or parcel data to determine the total number of homes impacted. In Morgan and Tooele counties the number of homes impacted was then multiplied by the average housing value as reported by the County assessors' office, to determine the total value of potential loss. The average house value used for Morgan County was \$187,780, and \$125,268 for Tooele County. In the case of wildfire and earthquake the value of the land (20% of total) was subtracted from the totals reported in the vulnerability tables. This was done because wildfires and earthquakes do not usually render the land useless as landslides often do. Additionally, content values are not included, which would raise the potential loss numbers for housing by approximately 50%.

In addition to the above methodology, earthquake was profiled using HAZUS MH, which is shorthand for Hazards United States. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses.

Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

The HAZUS Model estimates building losses, numbers of shelters required for displaced households, amounts of debris generated, and numbers of casualties. A HAZUS report was completed for each of the counties covered in this plan.

The potential impact of natural hazards on transportation and utilities was determined in a similar method as described above. Roads and utilities were overlaid on the hazard areas and the impacted utility and road segments were inventoried. Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS MH and the Utah Department of Transportation. These costs include:

Item	Cost per Mile
Local Roads	2,000,000
State Highways	2,413,500
US Highways	2,413,500
US Interstates	3,600,000
Power Lines	48,280
Gas Lines	241,390

In addition to the linear features, point data from HAZUS MH including critical facilities, dams, care facilities, schools, power generation facilities, and substations were analyzed to determine if the feature was within a hazard area.

Limited availability of digital data presented a problem in completing the vulnerability assessment. Potential loss numbers were only determined for earthquakes, landslides, problem soils and wildfires in this plan. Additional limitations to the above described analysis method includes:

- Assuming random distribution
- Limited data sets for water, gas, electrical, resulting in, incomplete numbers for these features.
- Lack of digital parcels data for Morgan and Tooele Counties.
- No digital data for dam failure inundation, flood plains, or infestation.
- Relied on state wide data not intended for manipulation at the scale it was used.
- Data was not field checked, resulting in an analysis wholly dependent on accuracy of data.
- Meta data was lacking on some of the used data sets.

In terms of hazard mapping presentation in this document, simple maps were created to provide a graphical illustration of location. These maps are done at a scale, which allows them to fit on a standard letter sized page. Larger maps can be plotted out upon request. Data manipulation and maps were created as a planning tool, to be used, by interested persons within the WFRC and the jurisdictions the AOG serves. This information should not take the place of accurate field verified mapping from which ordinances need to be based off of.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can only identify areas, which need additional research before development should be allowed. No viable source of data exists for this study area to facilitate analysis of future development. Limited zoning data was available but this data does not necessarily indicate which, areas will be developed and which will not.

## **D. Mitigation Goals, Objectives, Actions**

Using the findings from the risk assessment and the capabilities assessment as a guide several mitigation actions were identified that would benefit each jurisdiction. Each action has been formalized and placed into this plan in each of the county mitigation sections. These actions were identified in the planning group meetings, which included input from the core planning team, local planning team, state and local agencies, county government, and city and county residents.

Goals and objectives were developed in a working session between the above-mentioned figures with a period provided for comment and revision.

Each of the jurisdictions identified mitigation actions based on the identified goals and objectives. These actions are included in every county portion of this plan Section G. The mitigation actions identify the responsible agency, the funding source, timeline, background, and their priority. Actions were selected using the information obtained from the capabilities assessment, which identified existing programs and shortfalls related to mitigation activities. The actions were prioritized based on the STAPLEE method identified in the FEMA How to Guides. Prioritization emphasized the effectiveness of the actions with respect to their cost, as well as their social, technical, administrative, political, legal, environmental, and economic effects. Each of the actions were judged and ranked against these criteria and assigned the priority of High, Medium, or Low.

## **E. Hazard Description**

Each of the natural hazards that could affect Utah, including the Southeast region, have been described below. These are general descriptions about each hazard to give an idea of what, why, when, and how the hazards occur.

## 1. Earthquake

According to Sandra Eldridge, (Utah Natural Hazards Handbook 4-15), an earthquake is the result of "...sudden breakage of rocks that can no longer withstand the stresses that build up deep beneath the earth's surface"(5). The energy that is released is abrupt shaking, trembling or sudden motion in the earth and rocks that break along faults or zone of weakness along which the rocks slip. Seismic waves are then transmitted outward and also produce ground shaking or vibrations in the earth. The Richter scale measures the magnitude of earthquakes on a seismograph. A Richter magnitude 6 earthquake is 30 times more powerful than a Richter magnitude 5. A Richter magnitude 7 is 1000 times more powerful than a Richter magnitude 5. In order for humans to feel an earthquake is usually needs to be at least a magnitude 2.0. In order for significant damage to occur an earthquake needs to be at least a magnitude of 5.5 or greater. The amount of damage that occurs from an earthquake depends on soil type, rock type, ground-water depth, and topography. Other factors include the type of construction in an area and the population density. The Utah region records approximately 700 earthquakes a year, and an average of 13 of those are of magnitude 3.0 or greater. A magnitude 5.5 to 6.5 earthquake occurs in Utah every 7 years (4-5).

Locations and Activity: Faulting can be evident on the earth's surface or not evident at all, therefore earthquakes are believed to be able to occur anywhere in Utah (6-8). The earthquake history of WFRC is complicated by the fact that we have not had a large recorded earthquake during recorded historical time. The geographic area comprising WFRC last produced a major earthquake, approximately 1,350 years before present. Yet, when looking at the region, the potential for a large earthquake exists when one considers that "since 1850 at least 16 earthquakes (excluding aftershocks) of magnitude 6.0 or greater have occurred within the ISB" (Eldredge 6). The greatest earthquake hazard is considered to be in the areas surrounding the Wasatch, East Cache, East Bear Lake, Bear River, Hansel Valley, Northern Oquirrh, West Valley, and East Great Salt Lake fault zones. Other areas of significant hazard along the southern portion of the ISB include Hurricane, Paragonah, and Sevier faults. The other significant hazard areas in Central Utah are the Stansbury, Joes Valley, and Gunnison faults (7). On the Wasatch fault, the segments between Brigham City and Nephi the "composite recurrence interval for large surface-faulting earthquakes (magnitude 7.0 to 7.5) is  $395 \pm 60$  years.

Average number of earthquakes occurring in Utah	
Magnitude	Frequency
$\geq 3.0$	6 per year
$\geq 4.0$	1 per year
$\geq 5.0$	1 every 4 yrs
$\geq 5.5$	1 every 10 yrs
$\geq 6.0$	1 every 20 yrs
$\geq 6.5$	1 every 50 yrs
$\geq 7.0$	1 every 150 yrs
$\geq$ = greater than or equal to	

(Source: University of Utah Seismograph Stations)

The most recent surface-faulting earthquake on the Wasatch fault occurred 400 years ago on the Nephi segment" (Eldredge 7). The two largest historical earthquakes to occur in Utah were the Richfield earthquake of 1901, with a magnitude of 6.5 and the Hansel Valley earthquake of 1934 with a magnitude of 6.6.

Chart 1.1 Average number of earthquake occurring in Utah.

*The Hansel Valley earthquake produced MM intensities of VIII in Salt Lake City, with numerous reports of broken windows, toppled chimneys, and structures twisted on their foundations. A clock mechanism weighing more than 2 tons fell from the main tower of the Salt Lake City County Building and "crashed through the building" The only death that occurred during the event was caused when the walls of an excavation collapsed on a public-works employee south of downtown Salt Lake City (Qtd. in Lund 20).*

Utah's most damaging earthquake was of a smaller magnitude (5.7), which occurred near Richmond within Cache Valley during 1962. This earthquake damaged over 75 percent of the houses in Richmond, as well as roads and various other structures. The total damage in 1962 dollars was about one million dollars.

The Utah Seismograph Stations records about 700 earthquakes each year; only about 13 of these have a magnitude of 3.0 or larger.

*"Earthquakes in 1909, 1914, and 1943 produced MM intensities in Salt Lake City of up to VI, and earthquakes in 1910, 1949, and 1962 had MM intensities of VII in Salt Lake City. Damage produced by*

*these events included broken windows, cracked walls, fallen plaster, toppled chimneys, and buildings shifted on their foundations. The 1949 earthquake also ruptured a water main causing loss of water to a portion of the city” (Qtd. in Lund 20).*

On average a moderate, potentially damaging earthquake (magnitude 5.5 to 6.5) occurs in Utah every 7 years. The history of seismic activity in Utah and along the Wasatch Front suggests that it is not a matter of “if” but when an earthquake will occur.

**Secondary Hazards:** Associated earthquake hazards include ground shaking, surface fault rupture and tectonic subsidence, soil liquefaction, flooding, snow avalanches, dam failure, fire, and slope failure.

**Ground Shaking:** Ground shaking is caused by the passage of seismic waves generated by an earthquake. Shaking can vary in intensity but is the greatest secondary hazard because it affects large areas and stimulates many of the other hazards associated with earthquakes. The waves move the earth’s surface laterally and horizontally and vary in frequency and amplitude. High frequency, small amplitude waves cause more damage to short, stiff buildings. Low frequency, large amplitude waves have a greater effect on high-rise buildings. The intensity depends on geologic features such as bedrock and rock type, topography, and the location and magnitude of the earthquake. Other significant factors include ground water depth, basin shape, thickness of sediment, and the degree of sediment consolidation. Moderate to large earthquake events generally produce trembling for about 10 to 30 seconds. But aftershocks can occur erratically for weeks or even months after the main earthquake event (7-8).

**Surface Fault Rupture and Tectonic Subsidence:** Surface fault rupture or down dropping and tilting associated with tectonic subsidence can rupture the ground surface and in Utah the result is the formation of scarps or steep breaks in the slope. The Hansel Valley (1934) earthquake resulted in a surface displacement of approximately 1.6 feet. Surface faulting in the central segments of the Wasatch fault are expected to have the highest potential. Also earthquakes having a magnitude of 6.5 or greater could result in surface faulting of 16 to 20 foot high and 12 to 44 mile long break segments. Surface displacement generally occurs over a zone of hundreds of feet wide called the zone of deformation. Tectonic subsidence generally depends on the amount of surface fault displacement. The greatest amount will be at the fault and will gradually diminish out into the valley (8-10).

**Soil Liquefaction:** Liquefaction occurs when there is a sudden large decrease in shear strength of sandy soils caused by the collapse of the soils structure, in which the soil loses its bearing capacity, and also by a temporary increase in pore-water pressure, or water saturation during earthquake ground shaking. Liquefaction is common in areas of shallow ground water and sandy or silty sediments. Two conditions must be met in order for soils to liquefy; (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong enough to cause susceptible soils to liquefy (Lips). The result is soils that will flow even on the gentlest of slopes. Lateral spreading is a type of failure that results in surficial soil layers breaking up and moving, up to 3 feet or more, independently over the liquefied layer. On slopes more than 5 percent, flow failures can move miles up to 10s of miles per hour. On slopes less than 0.5 percent the bearing capacity will lessen and can cause buildings to settle or tip. No matter the slope percent ground cracking and differential settlement will occur. Liquefaction can also cause foundation materials to liquefy and fail and/or cause sand boils. Sand boils are deposits of sandy sediment ejected to the surface during an earthquake along fissures. Liquefaction can occur during earthquakes of magnitude 5.0 or greater (10-11).

**Slope Failure:** Ground shaking can cause rock falls and landslides in mountainous or canyon areas. Rock falls are the most common slope failure and can occur up to 50 miles away from a 6.0 magnitude earthquake. Landslides occur along benches in wet unconsolidated materials. During a 6.0 magnitude earthquake, landslides may occur within 25 miles of the source (11).

**Flooding:** “Flooding can happen due to tectonic subsidence and tilting, dam failure, seiches (waves generated in standing bodies of water) in lakes and reservoirs, surface-water diversion or disruption, and increased ground-water discharge”, According to the Natural Hazards Handbook 11.

Snow Avalanches: Avalanches could be triggered because of the associated ground movement. The most vulnerable areas include those that have steep terrain, high precipitation, high earthquake potential, and high population density. An example of this area in Utah would be the Wasatch Front (11-12).

Sensitive Clays: Sensitive clays are a soil type that losses strength when disturbed and result in liquefaction or collapse. The resulting type of ground failure is similar to liquefaction (12).

Subsidence: A settling or sinking of the earth's crust in loose granular materials such as sand and gravel that do not contain clay. Western Utah is subject to this type of ground settlement (12).

Figures 6-1-1, 6-1-2, and 6-1-3 identify earthquakes with a Richter magnitude of 3.0 or higher and where in the County they are located between 1962 and 1993, courtesy of Kory Iman.

Figure 6-1-1

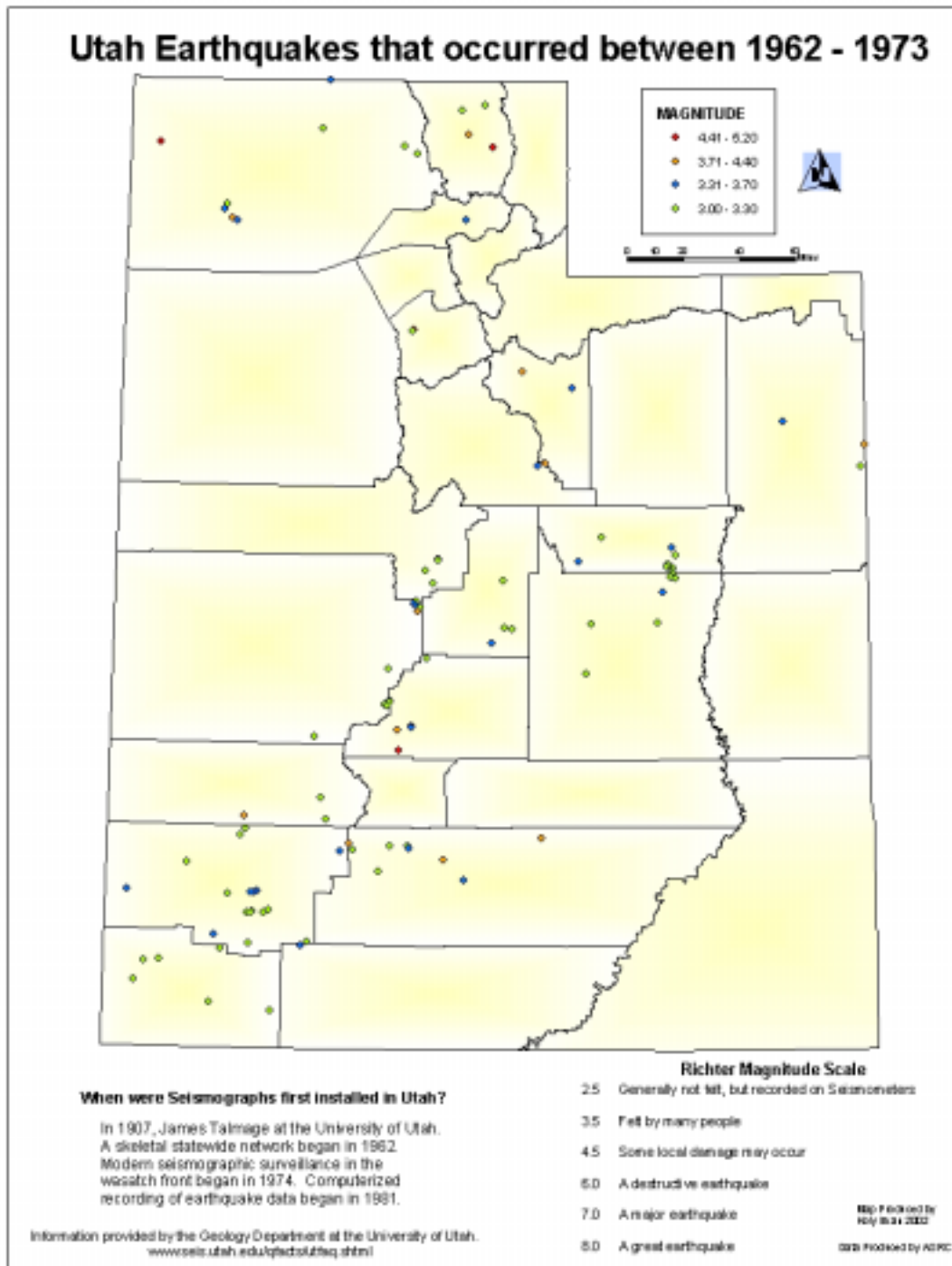


Figure 6-1-2

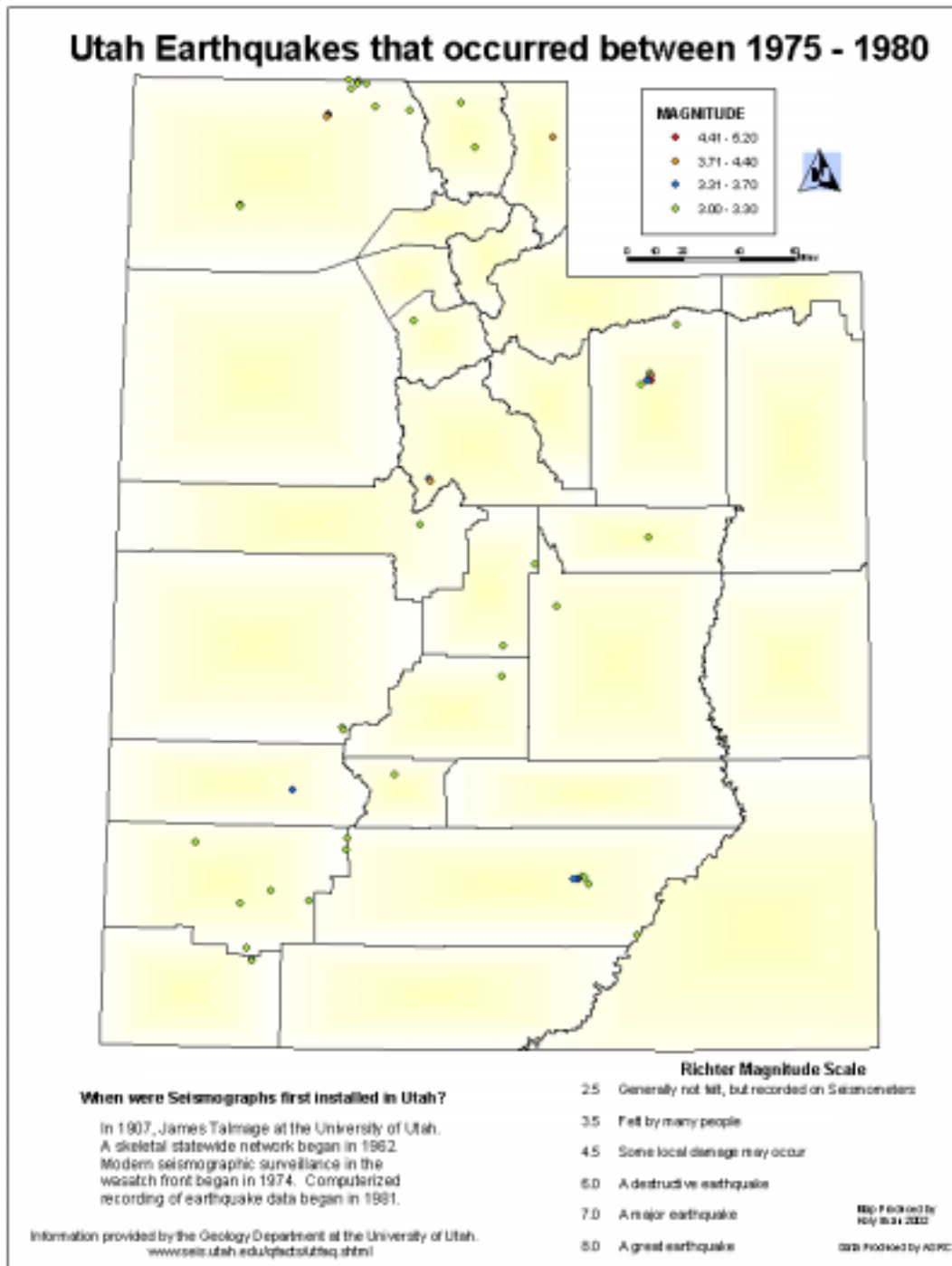
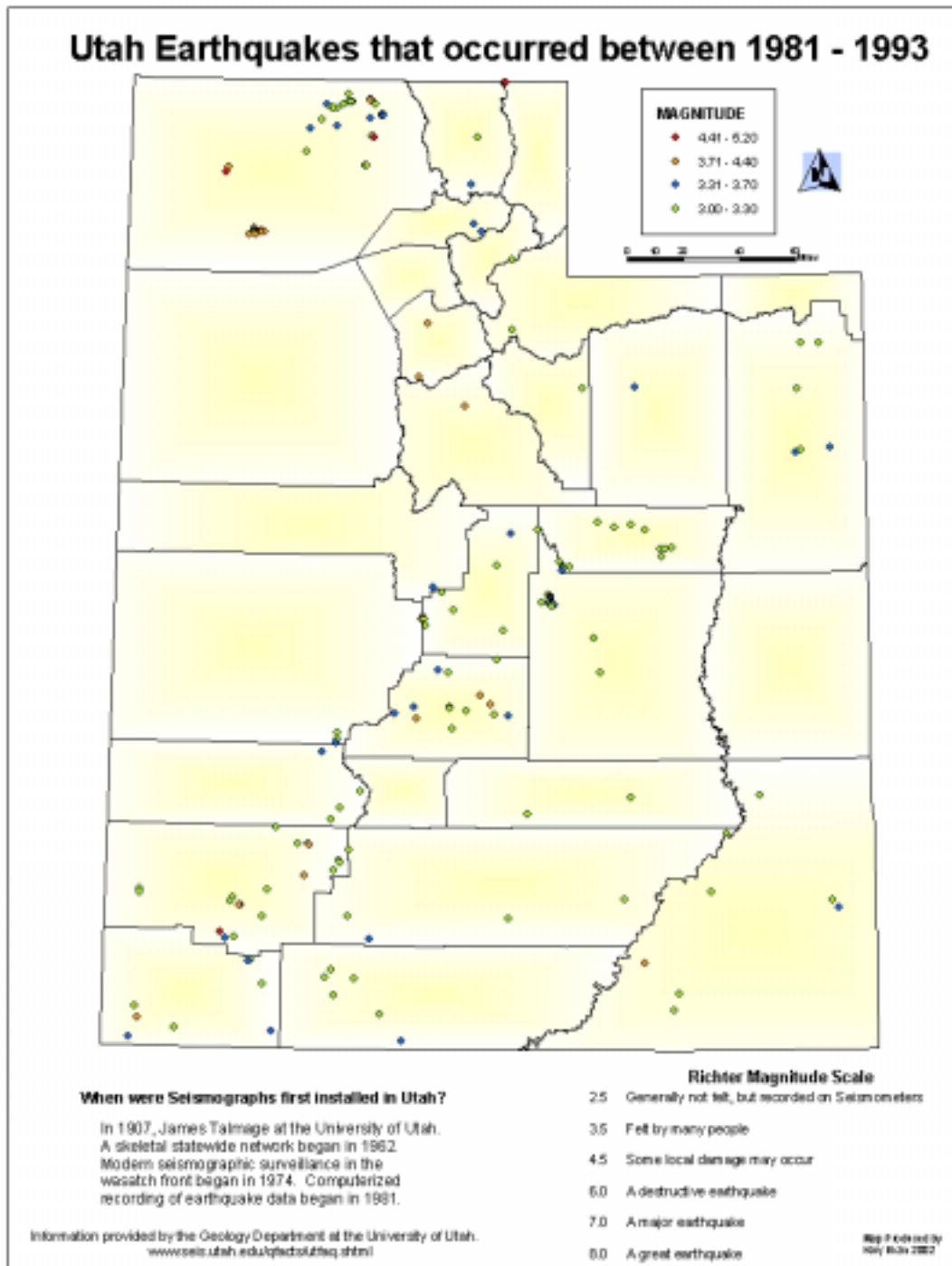


Figure 6-1-3



## 2. Flood

It is important to note that flooding is a natural event for rivers and streams. Flood is determined to be the overflow of water onto land that is normally dry. Floods are related to an excess of snowmelt, rainfall, or failure of natural or engineered impoundments onto the banks and adjacent floodplains. Floodplains are lowland areas near river, lakes, reservoirs, oceans, and low terrain urban areas that are subject to recurring floods. Flooding occurs when the peak discharge, or rate of flow in cubic feet per second, is larger than the channel of the river or the storm sewer capacity in a city. The peak discharge for a stream is associated with a probability of occurrence. The probability of occurrence can be stated in terms of recurrence intervals or return periods. For example, a probability of occurrence of 10 percent would be a flood expected to occur once in 10 years or 10 times in a 100 years. Flooding damage includes saturation of land and property, erosion from water, deposition of mud and debris, and the fast flowing waters from the flood itself. Most injuries and deaths occur from the fast moving floodwaters and most of the property damage results from the inundation by sediment-filled water. Flash flood conditions result from intense rainfall over a short period of time (Utah Natural Hazards Handbook 42-45).

Snowmelt floods occur from the rapid snowmelt in the mountains. These floods generally happen in April, May and June. Warm air masses with mostly sunny skies melt the mountain watershed snowpack. The large accumulations of water generally last several days and the magnitude depends on the amount of snowpack and the warm weather. Snowmelt flood risk is reduced when the snowpack is below normal and/or the weather changes from winter to spring and summer gradually without an abrupt warming trend (43).

Rainfall floods result from large amounts of precipitation. Short duration local storms such as cloudburst or thunderstorms with a high intensity rainfall as well as the general storm that last several days with a less intense rainfall can produce a flooding event (43).

Areas prone to flooding, according to the Utah Natural Hazards Handbook, include lake and reservoir shorelines, which may flood when the flow of water into the lakes or reservoirs is greater than the outflow capacity. The Great Salt Lake and Sevier Lake are known as terminal lakes, which mean they do not have an outlet. These types of lakes are subject to considerable variations in water levels because the only outflow is by evaporation. Successive wet or dry periods that last several years result in a large change in size in terminal lakes. Development near this type of lake during a dry period is risky and certain to get flooded during wet periods (44).

River and creek floodplain areas range from narrow zones to extensive lowlands extending great distances from a natural drainage area. Construction in floodplains is also dangerous because of the high flood risk.

Urban areas are also prone to flooding because of the decrease in vegetation of the natural watershed. Houses, driveways, parking lots, buildings, and streets are all replacing the vegetative cover that is so important in lessening the potential for flood. This type of development prevents water infiltration into the soil and greatly increases the runoff. In some areas undersized piping and channels are used which may cause flooding. Manmade drainage ways can also play a role in flooding, trash and debris can obstruct passageways (44).

### 3. Landslide

Utah ranked third in the nation in terms of largest total landslide damage cost and cost per person between 1973 and 1983. Utah's landslide hazard rating is "severe" which is the highest level of five hazard classes given by the Geological Survey. The three main contributing factors to slope failure include areas with moderate to steep slopes, conducive geology, and high precipitation. The main elements that cause slope failure include precipitation events, topography and vegetation (Utah Natural Hazards Handbook 16-22).

Landslide distribution in Utah is associated with topography and physiographic provinces. The two physiographic regions that are conducive to landslides in Utah are the Middle Rocky Mountains province and the High Plateaus subdivision of the Colorado Plateau physiographic province.

Landslides are also known as slope failure and are classified according to the type of movement and the material involved. The five types of movement include falls, topples, slides, lateral spreads, and flows. The types of materials include rocks, debris (course-grained soil), and earth (fine-grained soil). Slope failure types are identified as rock falls, rock topples, rock slides, debris flows, debris topples, debris slides, slumps, and earth flows (17-18).

Rock Falls and Rock Topples occur when loosened blocks or boulders from an area of bedrock move down slope. Rock falls and topples generally occur along steep canyons, cliffs, and steep road cuts. Rock fall damage usually affects roads, railroad tracks, and utilities.

Debris Slides and Debris Flows generally occur in mountainous areas and involve the relatively rapid, viscous flow of course-grained soil, rock, and other surficial materials. Debris flows generally occur in mountainous areas and are considered a flow rather than a slide because of the high water content coupled with the debris. Debris flows are typically more dangerous because of the high speeds under which they form and travel. Debris flows generally remain in stream channels but can flow out from canyon mouths for a considerable distance. Debris flows and slides can damage anything in their path including buildings, roads, railroad tracks, life lines/utilities, and reservoirs.

Slumps are common along road embankments and river terraces. They slip or slide along a curved failure plane away from the upper part of a slope leaving a scarp (a relatively steeper slope separating two more gentle slopes). Slumps generally do not move very far from the source area.

Earth Flows are slumps with the addition of water that slump away from the top or upper part of a slope, leaving a scarp. These can range in size from very small to flows involving hundreds of tons of material and result in a bulging toe that can block streams and cause flooding, and damage buildings or other structures.

Causes of landslides are the result of hillside instability. Slope makeup, slope gradient, and slope weight all play a role. Other important factors of slope instability include rock type and structure, topography, water content, vegetative cover, and slope aspect. Debris flows, for example, occur when these elements are modified by natural processes or by human created processes.

Natural processes that can induce slope failure include ground shaking, wind and water weathering and erosion.

Human created processes involve lawn watering and irrigation. Excess water is the leading cause of landslides because water adds weight to the strength of the material and raises the pore pressure leading to a loss of shear strength. Water can also change the consistency of the slope material reducing cohesion leading to an unstable mixture. Rock types containing clay, mudstone, shale, or weakly cemented units, which, are strongly affected by weathering and erosion are particularly prone to landsliding because of the expansive and lubricating properties. Other processes include the removal or addition of slope materials during construction. Vegetation is very important in the stabilization of slopes because it prevents rainfall from impacting the soil directly and helps protect from erosion by retaining water and decreasing surface

runoff. The roots systems serve as slope-stabilizing elements by binding the soil together or binding the soil to the bedrock. Increase in slope gradient such as placing heavy loads at the top of a slope and /or the removal of material at the toe of a slope all affect the equilibrium and result in slope failure because of slope instability.

## 4. Wildfire

The Urban Rural Wildland Interface (URWIN) area, or I-Zone, is where residential areas meet wildland areas. It is known as the interface zone and presents a serious fire threat to people and property. The urban aspect includes homes, schools, storage areas, recreational facilities, transmission lines, and commercial buildings. Wildland refers to unincorporated areas including hills, benches, plateaus, and forests. Homes are built on the benches adjacent to wildland areas. Wildfires remove vegetation, which results in slope failure, erosion, water runoff and depletion of wildlife resources. The three conditions that affect fire behavior are topography, vegetation and weather (Utah Natural Hazards Handbook 23-28).

Topography includes such factors as slope, aspect, and elevation. Fires spread faster upslope because the fuels are closer to the flames on the upslope. The heat from a fire moves uphill and dries fuels in front of the fire allowing for easier ignition. The aspect of slope dictates moisture content. In other words, the sun dries out fuels on south and west facing slopes more than on north and east facing slopes. Elevation and weather are interrelated because, generally, higher elevations result in cooler temperatures and a higher relative humidity. Elevation also determines the types of vegetation present (24).

Vegetation plays a major role in the speed of a fire. Light grasses burn rapidly and heavy dense fuels burn slowly but with a greater intensity. The five major fuel types in Utah's vegetation include grass/sagebrush, pinion-juniper, mountain bush, hardwoods, and softwoods. The grass/sagebrush area poses a serious threat because people under-estimate the danger of wildfires in this area. These fires burn across thousands of acres rapidly and pose a serious threat to not only property but also life. Pinion-juniper fuel does not normally burn much, except when conditions are hot, dry, and windy. When a fire does happen here it will burn intensely and spread rapidly. Mountain brush is commonly found in Utah's foothills and if moderate to extreme fire conditions are present this type of fuel will burn hot and fast. Hardwood-forest and softwood (deciduous) fuel types are generally less risky (24).

Size, continuity and compactness all affect the fuel's rate of spread. Large fuels do not burn as readily as smaller fuels and need more heat to ignite. Small fuels on the other hand ignite easier, and a fire will spread more rapidly through them. Continuity is described by how fuel is arranged horizontally. Fuels that are broken up burn unevenly and usually slower than uniform fuels. Compactness is how fuel is arranged vertically. Tall, deep fuels have more oxygen available so they burn more rapidly. Less oxygen is available to compact fuels such as leaf litter and stacked logs therefore they burn slower (24).

Weather, is made up of a few different factors namely temperature, humidity, precipitation, and wind. Weather affects the ease with which a fuel ignites, the intensity at which it burns, and how easy the control may be. High temperatures increase fire danger because they heat fuels and reduce water content, which increases flammability. Humidity influences fuel ignition and how intensely fuel burns. A decrease in relative humidity causes the fuel to become drier and will ignite easier and burn more intensely. Wind can increase burning in the direction that it is moving. Wind carries heat from a fire into unburned fuels drying them out and causing them to ignite easier. The wind may also blow burning embers into unburned areas ahead of the main fires starting spot fires (25).

Fire protection in these areas is difficult because the tactics used for wildland-fire suppression cannot be used for structure protection and suppression. The energy that is emitted from a wildland-fire is very dangerous to firefighters and homeowners and makes protection of homes almost impossible. One third of all firefighter deaths occur fighting wildfires. Many believe that URWIN areas increase the risks to firefighters significantly. Legally federal wildland protection agencies seldom have the responsibility to protect structures, and the legal responsibility for protecting structures on non-federal wildlands varies widely among state forestry agencies (26).

## 5. Dam Failure

Dams serve various functions and are built by different agencies and entities. Such agencies and entities include The Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, cities, counties, and even the private sector. Dams are built for uses such as hydroelectric power generation, flood control, recreation, water storage for irrigation, as well as municipal and industrial uses. Because of Utah's dry summers, it is critical that the winter snowfall is stored for uses all year round. 84% of Utah's stored water is behind federal dams, 650 non-federal dams hold more than 1.2 million acre-feet of water. Dam placement is important and needs to be in an area where they can collect and distribute the greatest amount of water. Dam sites with strong impermeable bedrock are the best in terms of strength. Other materials can be used to construct a dam such as earthen fill, concrete, roller compacted concrete, and rocks and mine tailings. Other dams are created by the enlargement or addition of existing lakes (Utah Natural Hazards Handbook 47-48).

“Rainy Day failures occur when floodwaters overstress the dam, spillway, and outlet capacities. The floodwater flows over the top of the dam and eventually erodes the structure from the top down. At this point the floodwater meets with the floodwaters from the rainstorm and a very destructive, powerful flood is created” (47).

Sunny Day failures are the most dangerous because they happen without any warning. Downstream residents or inhabitants have no time to prepare or even evacuate the area; the results are generally very catastrophic. Sunny day failures occur from seepage or erosion inside the dam. This erosion removes fine materials creating a large void that can cause the dam to collapse, or overtop and wash away. Earthquake ground shaking or liquefaction can also create structure problems. Ground shaking will cause the dam to start piping, slumping, settling, or experience a slope failure similar to a landslide. The dam would then fail internally or overtop and wash away. Other sunny day failures occur when vegetation or rodents get into a dam and leave holes or tunnels that can lead to failure. Not all dam failures are catastrophic; sometimes a dam can fail and be drained and repaired without a damaging flow of floodwaters (47).

“Hazard ratings are determined by downstream uses, size, height, volume and incremental risk/damage assessments. The hazard ratings are: Low- insignificant property loss; Moderate- significant property loss; and High- possible loss of life” (48). Over two hundred of Utah dams are rated as high-hazard dams.

## 6. Drought

According to the Drought Hazard Mitigation Plan, drought originates from a shortage of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. “Drought could be considered relative to some long-term average condition of balance between precipitation and evapotranspiration in a particular area”. Drought is also related to the timing and effectiveness of the rains. Drought is a normal, recurrent feature of weather and climate but is a particular concern to all affected because of its devastating outcome. It occurs in almost all climatic zones with varying characteristics. “Drought is a temporary aberration and differs from aridity since aridity is restricted to low rainfall regions and is a permanent feature of climate”. Drought is a dry progression through the winter, spring, and summer months that could end in a year or last for many years. The number of dry years correlates with those affected, usually a one to two year drought affects only agriculture, while a three-year drought typically results in impacts on culinary water in the local areas and communities (13-15).

Conceptual definitions of drought help people understand the idea of a drought.

Operational definitions define the process of drought. This is usually done by comparing the current situation to the historical average, often based on a 30-year period of record. It is hard to develop a singular operational definition of drought because of the striking differences throughout the world (Defining Drought).

Meteorological drought is defined by the degree of dryness in comparison to an average amount and the duration of the dry period. Meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region (13-15).

Hydrological drought refers to the precipitation decline in the surface and subsurface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale (13-15).

Agricultural drought occurs when there is not enough water available for a crop to grow. This drought links various characteristics of meteorological or hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced ground water or reservoir levels (13-15).

Socioeconomic drought occurs when the physical water shortage begins to affect people (16-20).

When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface and subsurface water are usually the last to be affected. Ground water users are often the last to be affected by drought during its onset but may be the last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the episode terminates (18-19).

### Measuring Drought:

Palmer Drought Severity Index (PDSI): Wayne Palmer developed the PDSI in 1965. The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions used by government agencies and states to trigger drought relief programs. The PDSI provides a measurement of moisture conditions that were “standardized” so that comparisons using the index could be made between locations and between months. This is the oldest index for measuring drought and is less well suited for mountainous land or areas of frequent climatic extremes and does not include man-made changes. The PDSI is calculated based on precipitation and temperature data as well as local available water content of the soil. This scale is given as

monthly values and is the most effective in determining long-term drought. The index ranges from -4 to 4 with negative values denoting dry spells and positive values indicating wet spells. The values 0 to -.5 equal normal, -.5 to -1.0 equal incipient drought, -1.0 to -2.0 equal mild drought, -2.0 to -3.0 equal moderate drought, -3.0 to -4.0 equal severe drought, greater than -4.0 equals extreme drought. The wet spells use the same adjectives in the positive values (What is Drought).

Surface Water Supply Index (SWSI): Shafer and Defman developed the SWSI in 1982. This index uses the same basic classifications as the Palmer Drought Index and is designed to complement the Palmer in the western states. The SWSI is more of an indicator of surface water conditions and described as “mountain water dependent”, in which mountain snowpack is a major component; calculated by river basin, based on snowpack, stream flow, precipitation, and reservoir storage. The objective of the SWSI was to incorporate both hydrological and climatological features into a single standardized index value. The pros and cons of the SWSI is that the index is unique to each basin. The SWSI is centered on 0 and has a range between -4.2 (extremely dry) and 4.2 (abundant supply). The index is calculated by combining pre-runoff reservoir storage with forecasts of spring and summer stream flow that is based on hydrologic variables (What is Drought).

Standardized Precipitation Index (SPI): T.B. McKee, N.J. Doesken, and J. Kleist of the Colorado State University, Colorado Climate Center formulated the SPI in 1993. The Standardized Precipitation Index was designed to quantify the precipitation deficit for multiple time scales; basically, the SPI is an index based on the probability of precipitation for any time scale. It assigns a single numeric value to the precipitation that can be compared across regions with different climates. The SPI is calculated by taking the difference of the precipitation from the mean for a particular time scale and dividing by the standard deviation. The SPI is normalized and so the wetter and drier climates can be represented in the same way. The SPI can provide early warning of drought and help assess drought severity yet the values based on preliminary data may change. The SPI values indicate an extremely wet period value at 2.0+, very wet equals 1.5 to 1.99, moderately wet is 1.0 to 1.49, -.99 to .99 is near normal, -1.0 to -1.49 moderately dry, -1.5 to -1.99 is severely dry, -2 and less is extremely dry. The time scales were originally calculated for 3-, 6-, 12-, 24-, and 48- months (What is Drought).

After review of 33 gaging stations, the drought analysis in Utah indicated that a localized drought has occurred on at least one stream every year since 1924. The duration of drought lasts longer in basins where runoff is mainly from snowmelt. The frequency of occurrence is greater for areas in the Wasatch Range than in the Wasatch Plateau, the mountain of southwestern Utah, or the Uintah Mountain range. Because Utah relies on surface water supplies, about 81% of the population relies on offstream water use and 35% of the population relies on surface water supplies, drought severely affects the people and industry of the whole state.

## 7. Infestation

Infestation has plagued this region since the early 1800's and continues to be a problem. Infestation is known as a parasite that over-populates in numbers or quantities large enough to be destructive, threatening, or obnoxious. Past infestation events have been devastating enough for presidential disaster declarations because of the destruction to food supplies that affect wildlife, livestock, and agricultural lands including alfalfa, wheat, and barley. Crickets, katydids, grasshoppers, and worms tend to be the most damaging and affect the rural areas the most. With the recent drought in the area the predators decrease. The drought also affects the food supplies and so the insects begin to search over a wider area when in search of food.

## 8. Severe Weather

Avalanche: According to Sandra Eldredge, Utah Geological Survey "a snow avalanche is the rapid down-slope movement of snow, ice, and debris. Snow avalanches occur in the mountains of Utah as the result of snow accumulation and unstable snowpack conditions." Ground shaking, sound, or a person treading in an avalanche area can trigger a slide that can cover a wide area or can be concentrated to a smaller more or narrow path. An avalanche consists of a starting zone, a track, and a runout zone. The starting zone is where the ice or snow breaks loose and starts to slide; this zone can be triggered by human and/ or natural activities. Human induced avalanches can result from snowmobilers, backcountry skiers, or other outdoor recreationalists triggering the avalanche because of ground shaking. The two main natural factors that affect avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Other factors that contribute to the stability of the snowpack include the amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. The Track is the grade or channel down which an avalanche travels. The runout zone is where an avalanche stops and deposits the snow. For large avalanches, the runout zone can include a powder-or windblast zone that extends far beyond the area of snow deposition. In Utah, avalanches are the number one natural hazards that kill more people and ironically are triggered by the victim. Each winter an average of four people die in Utah due to avalanche activity (Utah Natural Hazards Handbook 50-53).

Weather and terrain conditions affect avalanche conditions. The weather controls the durations and the extent of an avalanche while terrain is the element that determines where, why, and how an avalanche occurred. In Utah, the months of January through April pose the greatest avalanche potential. Weather related aspects that affect the snowpack stability include rate of accumulation, amount of snowfall, moisture content, wind speed and direction, and snow crystal type. Wind can deposit snow 10 times faster than snow falling from a storm without accompanying wind. This affects avalanche potential because the underlying weak layer of snow cannot adjust to the new load. Rain and the melting of snow can almost instantly cause an avalanche because of the added weight 50-51).

Terrain includes such variables as slope, aspect, elevation, roughness and angle. The slope is important in understanding where an avalanche will occur. Slopes greater than 45 degrees are too steep because the snow continually sluffs off, however slopes greater than 20 degrees can produce avalanches. Optimum slope degree is between 30 to 45 degrees, which is also the optimum angle for backcountry skiers. This slope angle is where approximately 99.9 percent of avalanches occur. The slope aspect and elevation affect the snow depth, temperature, and moisture characteristics of the snowpack. Slope aspect, such as north facing or shady slopes usually produce more avalanches and more persistent avalanche hazards occur during mid winter months. In the spring, south facing slopes produce more wet avalanches from the strong sun (Utah Avalanche Center).

Slope shape and roughness correlate with snowpack stability. Roughness identifies boulders, shrubs, and trees that can help slow, or reduce avalanche speed and impact. A bowl shaped slope is more prone to an avalanche than a ridge or cliff.

Dry avalanche is when a cohesive slab of snow that fractures as a unit slides on top of weaker snow and breaks apart as it slides. Dry slab avalanches occur usually because too much additional weight has been

added too quickly, which overloads the buried weak layer, even the weight of a person can add a tremendous stress to a buried weak layer. Dry snow avalanches usually travel between 60-80 miles per hour within 5 seconds of the fracture and are the deadliest form of snow avalanche ([Utah Avalanche Center](#)).

Wet Snow avalanches occur for the opposite reason of dry avalanches; percolating water dissolves the bonds between the snow grains on the pre-existing snow, which decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour ([Utah Avalanche Center](#)).

Avalanches can result in loss of life as well as economic losses. What are at risk are some communities, individual structures, roads, ski areas, snowmobilers, backcountry skiers, snowshoers, snowboarders, and climbers. Avalanches can reach speeds up to 200 miles per hour and release enough force to wipe out everything in its path. One of the major consequences of snow avalanches is the burial of structures, roads, vehicles, and people in the runout zone where tens of feet of debris and snow can be deposited (51).

Severe Storm: Winter storms gain their energy from the collisions of two air masses. In North America a winter storm is usually generated when a cold air mass from dry Canadian air moves south and interacts with a northward moving warm moist air mass from the Gulf of Mexico. The position where a warm and a cold air mass meet is called a front. If cold air is advancing and pushing away the warm air the front is known as a cold front. If the warm air is advancing, it rides up over the cold air mass and the front is known as a warm front. A winter storm will typically begin under what is known as a stationary front. A stationary front is when neither air mass is advancing. The atmosphere will try to even out the pressure difference by generating an area of lower pressure; this creates wind that blows from high pressure towards a low-pressure area. As the air travels toward the center of the low-pressure area it is pushed up into the colder regions of the upper atmosphere because it has nowhere else to go. This causes the water vapor to condense as snow in the northern areas because of the colder temperatures. In the south, if the temperatures are warm enough the water vapor will fall as heavy rain in thunderstorms. Because of the easterlies in Northern America the winter storm moves quickly over the area and generally does not last longer than a day in one area. However, in Utah because of the Great Salt Lake “lake-effect” snowstorms can last for many days. This is because of the amount of moisture from an unfrozen body of water. When a strong cold wind blows over a larger area of water, the air can attain a substantial amount of moisture; this moisture turns into heavy snow when it reaches land causing a lake effect snowstorm ([All About Winter Storms](#)).

Strong winds often accompany a winter storm creating blizzard conditions; dangerous wind chill, severe drifting and can knock down trees, power lines, and utility poles ([Severe Weather Safety](#)).

Extreme Cold: Prolonged exposure to the cold can cause frostbite or hypothermia and can become life threatening ([Severe Weather Safety](#)).

Ice Accumulations can bring down electrical wires, telephone poles and lines, trees, and communication towers. Ice can also cause extreme hazards to motorists and pedestrians ([Severe Weather Safety](#)).

Heavy Snow can stop a region by stranding commuters, stopping the flow of supplies, disrupting emergency and medical services, close infrastructure and services ([Severe Weather Safety](#)).

Severe Thunderstorm usually last around 30 minutes and are typically only 15 miles in diameter. But they all produce lightning. They can also lead to flash flooding from heavy rainfall, strong winds, hail and tornadoes may also accompany a thunderstorm ([Severe Weather Safety](#)).

Extreme Heat: Heat-related illnesses affect people, this happens when their bodies are unable to compensate and properly cool themselves. Usually a body will sweat to cool itself, however under some conditions, sweating isn’t enough and a person’s body temperature will rise that can cause damage to the brain or other vital organs. This can happen when the humidity is high, sweat will not evaporate as quickly, preventing the body from releasing heat quickly; other conditions include age generally the elderly and young, obesity, fever, dehydration, heart disease, mental illness, poor circulation, sunburn, and prescription

drug use and alcohol use (Extreme Heat). Extreme heat can manifest in several ways including sunburn, heat exhaustion, heat stroke, and heat cramps (Severe Weather Safety).

Waterspouts are weak tornadoes that form over warm water and in Utah they can occur with cold late fall or with late winter storms (Tornadoes).

Tornado: Expressed as a violently rotating column of air extending from a thunderstorm to the ground. A tornado is often on the edge of the updraft or next to the air that's coming down from the thunderstorm. The tornado's vortex is a low-pressure area and as air rushes into the vortex, its pressure lowers and cools the air. This cooler air condenses into water vapor in the funnel cloud, known as the vortex, and doesn't touch the ground. The swirling winds of the tornado pick up dust, dirt, and debris from the ground, which turns the funnel cloud darker. Some tornadoes can have wind speeds up to 250 miles per hour or more with a damage zone of 50 miles long and 1 mile wide. But most tornados have winds less than 112 miles per hour, are less than 100 feet wide, and generally do not last longer than 10 minutes. They generally move along the ground 20-50 miles per hour. While a tornado can happen anytime, for the northern parts of the state tornadoes happen more frequently during the summer (Tornadoes). A change in wind direction and an increase in wind speed along with increasing height create an invisible, horizontal spinning effect in the lower atmosphere form a tornado while the rising air within the thunderstorm updraft tilts the rotating air vertically resulting in what we call a tornado. The area of rotation is generally 2-6 miles wide and extends through much of the storm (Tornadoes).

Scale: Tornadoes are classified by wind damage using the Fujita Scale that was accepted for use by the National Weather Service in 1973. The scale uses numbers from 0 through 5 with the ratings based on the amount and type of wind damage (Tornado Safety).

#### Fujita Scale

**F-0:** Winds up to 72 mph, Light damage, down tree branches, chimney damage

**F-1:** Winds 73-112 mph, Moderate damage, mobile home damage

**F-2:** Winds 113-157 mph, Considerable damage, mobile home demolished, trees uprooted

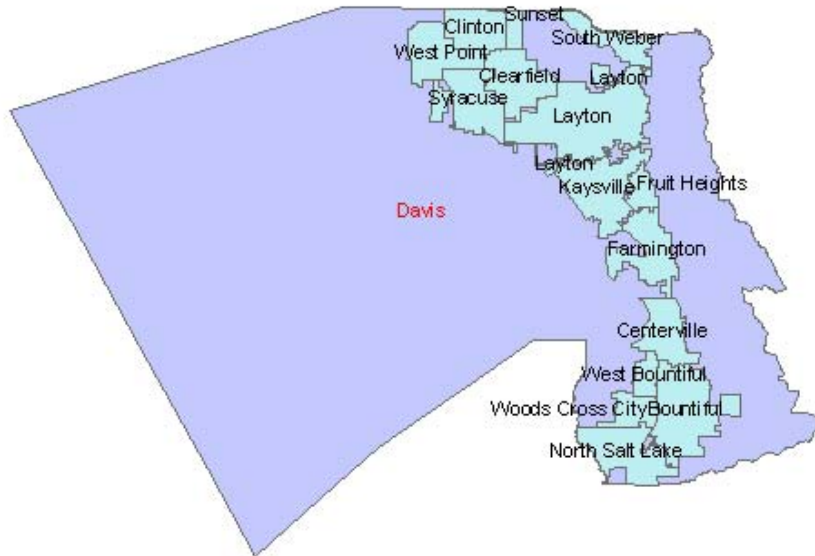
**F-3:** Winds 158-206 mph, severe damage, roofs and walls torn down, trains overturned, cars thrown

**F-4:** Winds 207-260 mph, Devastating damage, well-constructed walls leveled

**F-5:** Winds over 261 mph, incredible damage, homes lifted off foundation and carried, autos thrown as far as 100.

## Part VII. Davis County

Davis County includes 15 municipalities: City of Bountiful, Centerville City, Clearfield City, Clinton City, Farmington City, Fruit Heights City, Kaysville City, Layton City, City of North Salt Lake, South Weber City, Sunset City, Syracuse City, West Bountiful City, West Point City, and Woods Cross City. Davis County is located in Northern Utah.



### A. Demographics and Population Growth

The following information involving Population Estimates, Average Annual Rate of Change, and Population and Development Trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. Davis County population can be identified by reviewing Census 2000 data in the table below (Table 7-1).

**Table 7-1. Davis County Population Growth**

Census Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990- 2000	Percent Change 1990- 2000	AARC 1990- 2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Davis County	187,941	238,994	51,053	27.2%	2.4	3	3	13	13
Population by County and Multi-County									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000- 2030
Wasatch Front	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Davis County	146,540	187,941	238,994	262,241	292,201	323,992	347,412	386,672	1.62%

<b>Households by County and Multi-County</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Davis County	39,994	53,643	71,201	82,149	95,281	108,371	119,094	138,092	2.23%
<b>Average Household Size by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Davis County	3.58	3.44	3.31	3.15	3.03	2.95	2.88	2.76	-0.60%
<b>Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Davis County	10.03%	10.91%	10.70%	10.64%	10.48%	10.36%	10.31%	10.25%	-0.14%
<b>Household Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Davis County	8.92%	9.99%	10.15%	10.36%	10.42%	10.42%	10.42%	10.44%	0.09%
Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.									

## B. Economy

Grazing and agriculture were the first types of industry in the County. Many of the crops that were produced were sugar beets, tomatoes, alfalfa, grain, corn, potatoes, onions, and extensive fruit orchards. Dairy farming was also a leading industry.

Commercial and industrial companies are also located within the County including the Freeport Center, which is the largest distribution center in the United States. The Hill Air Force Base is also located in the County. Hill Air Force Base has been the economic backbone of Davis County for many years and is a fundamental economic component of the community. The economy is spread out between different entities namely, manufacturing, trade, services, and government. Some of the largest employers include Hill Air Force Base, Davis County School District, Lifetime Products Inc., Fred Meyer, Albertson's, and Davis County. Davis County is large and growing and the housing and community demands are high. Total personal income in millions in 2001 was \$6114.6 up from \$5790.3 in 2000. 2001 per capita income was \$24,973 and the average monthly nonfarm wage was \$2,392.

## **C. Transportation and Commuting Patterns**

Davis County transportation patterns were completed with the help of the UDOT Daily Annual Average Traffic Analysis of 2000. There are only two major highways within the county, Interstate 15 (I-15) and Interstate 84 (I-84). I-15 travels from the northern border of the county through the eastern portion into Salt Lake County to the south. I-15 connects the major cities in the county and experiences about 152,000 commuters each day. I-84 just enters the top eastern portion of the county and exits at the northeastern border. The average daily traffic traveling east west is about 10,405. Highway 89 travels north south from I-84 at the northern border of the county and connects with I-15. The daily traffic on this road is approximately 32,665. There are also four major State Routes namely, SR 272, SR 106, SR 225, and SR 277. SR 272 and SR 106 travel north south and together experience about 34,745 average daily trips. The combined daily use of SR 225 and SR 277 is approximately 12,505 average daily trips.

## **D. Land Use**

Davis County consists of 630 square miles with only 223 square miles actual usable land. Antelope Island is part of Davis County and adds another 42 square miles to the land area with the remaining portion part of the Great Salt Lake. Davis County is the third most populated county in the state with roughly 933 people per square mile. The percent of land ownership within the county is 10.9% Federal, 12.0% State, 24.9% Private and Local Government, and 52.2% under Water.

Davis County's population will continue to grow in the eastern and southern portions of the county where new development is occurring due to housing and land values that are slightly lower than nearby Salt Lake County. The Wasatch Mountain Range and the Great Salt Lake restrain development in Davis County. Therefore new development is located along the I-15 corridor and in the foothills. Other development is occurring where farmland and agricultural lands used to be.

Those portions of the county that are near the Great Salt Lake are subject to high liquefaction in the event of an earthquake and therefore pose a risk to incoming residents and new structures. One way for the county to mitigate the earthquake threat and its secondary risks is to continue to establish zoning ordinances and building codes that will recognize the threat and reduce it.

Wildfire risk is most severe in the foothills of northern Davis County. These areas known as URWIN zones are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. A couple ways to mitigate this threat is to encourage communities to become "Fire Wise Communities", continue to require building and zoning codes, and increase the public's awareness.

Landslide/ slope failure is another threat near the foothills of the Wasatch Mountain Range. Zoning ordinances and landslide studies will decrease the likelihood of a slope failure damaging property and the risk to life.

These are just some examples of the mitigation actions that can be put into place when new development occurs. Specific mitigation actions for Davis County can be found in Section G.

## **E. Risk Assessment**

The risk assessment process revealed the following for the identified hazards of Earthquake, Flood, Wildland Fire, Landslide/ Slope Failure, and Severe Weather. Severe Weather is considered to be a regional hazard and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 130 identified critical facilities within Davis County, for the complete list refer to Appendix D.

# 1. Earthquake

## Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Eastern areas of Bountiful, Centerville, Farmington, Fruit Heights, and Layton along the western portion of the Intermountain Seismic Belt. Ground shaking will be felt throughout the entire County. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in the high to moderate areas, from the foothill to the western portion of the county near the Great Salt Lake. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential is greatest near the Great Salt Lake along the low-lying areas of the county, in soils that are comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

## Description of Location and Extent

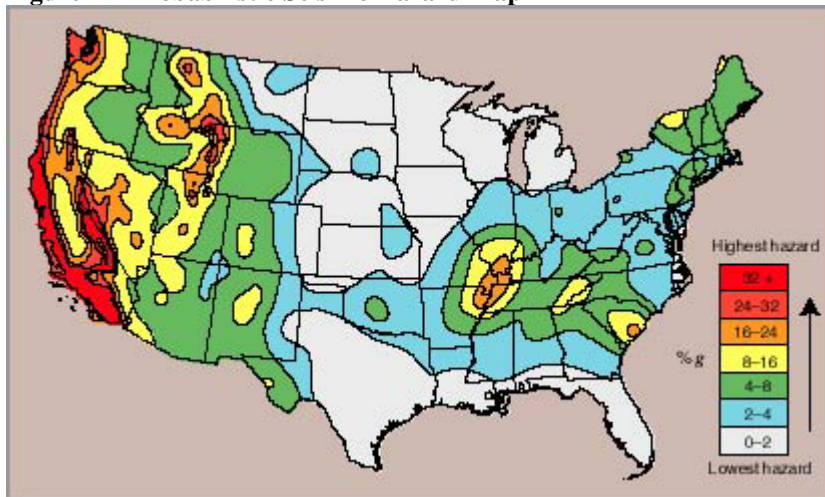
In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years.

Davis County is situated between two segments of the Wasatch Fault, the Weber Segment and the Salt Lake Segment. The Weber Segment runs from North Salt Lake along the eastern edge of the valley to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years, making it one of the most active fault segments. The Weber County segment of the Wasatch Fault could therefore create a magnitude 7.0 or above earthquake which would be very damaging to the entire county.

The Salt Lake Segment underlies the Salt Lake valley. The combined average repeat time for large earthquakes on any of the five central segments (Brigham city, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years. The average repeat time on any single segment ranges from about 1200-2600 years. The last earthquakes on the five central segment range from 620-2120 years ago. On the Salt Lake City segment the probability may be as high as 57 percent in 100 years.

According to the County Emergency Operations Plan Davis County contains the highest density of faults in the entire state of Utah. Davis County has felt earthquakes in the past but few earthquakes have had their epicenters within the county boundary.

**Figure 7-2 Probabilistic Seismic Hazard Map**



Using latitude and longitude, earthquake ground motion can be looked up on the USGS website for each city within Davis County (Table 7-2). This table identifies ground motion hazard values, Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These will be expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years.

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but of course is only approximate due to building design and demand. The probability of exceedence is based on some average probability per year, all probabilities are added, a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain time in years. The values listed are for the nearest grid point in decimal degrees 39.70000 Lat and -69.39999 Long

For a more detailed explanation of values used and metadata refer to the [USGS Earthquake Hazards Program](#) website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage. The cities of Anchorage, Arsenal, Fruit Heights, Kaneshville, and Layton coordinate systems were unable to be identified for earthquake probabilistic hazard values. The United States Geological Survey produced a seismic hazard map for the entire country; Utah according to the map is ranked towards the higher hazard values (Figure 7-2).

**Table 7-2 Earthquake Probabilistic Hazard- Ground Motion Values**

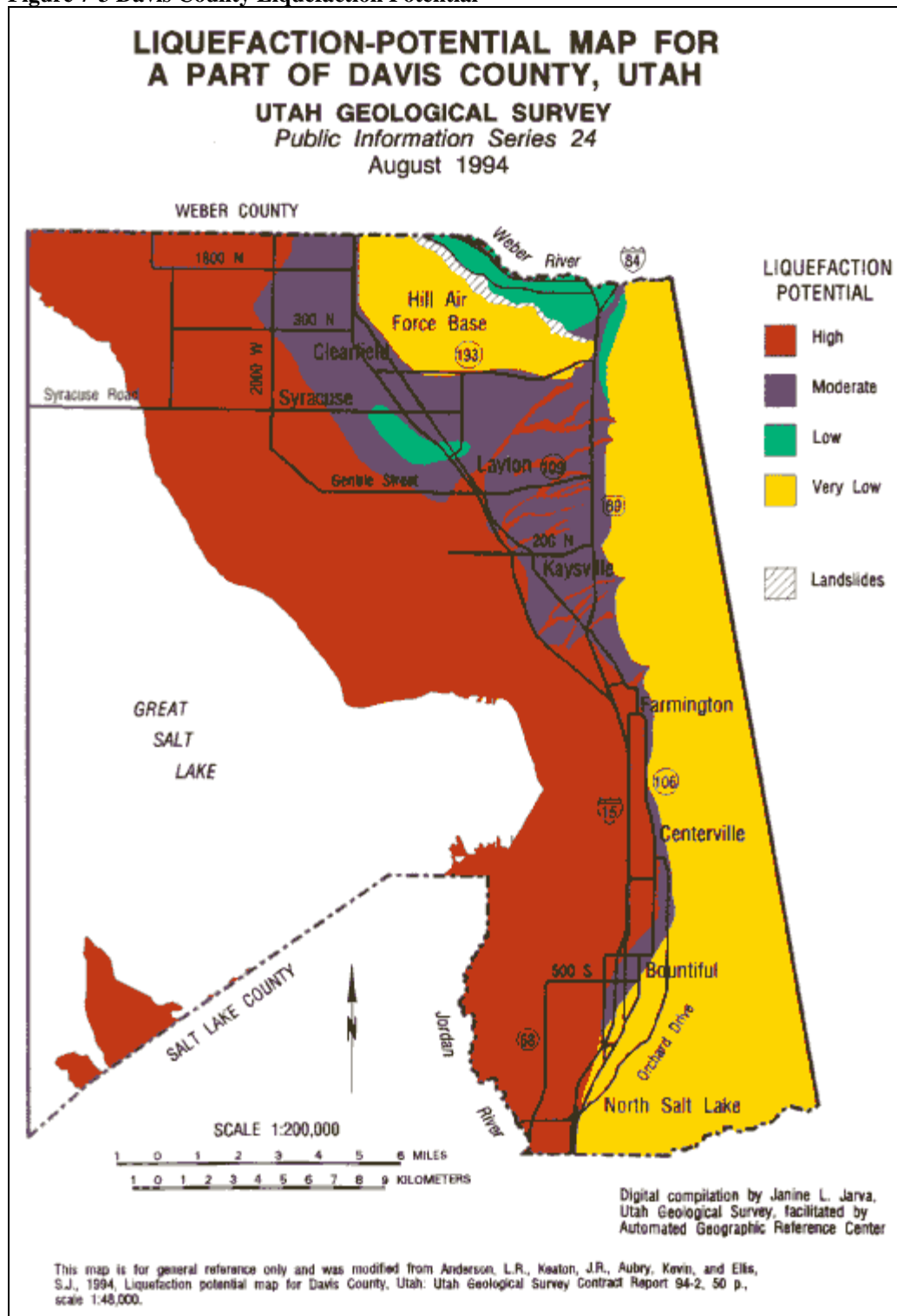
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
<b>Farmington 40:59:19 111:53:42</b>			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773

<b>South Weber 41:08:02 Lat 111:56:06 Long</b>			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307
<b>Sunset 41:14:91 Lat 112:03:305 Long</b>			
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
1.0 sec SA	0.8321668	1.549357	2.842664
<b>Bountiful 40:52:34 Lat 111:51:55 Long</b>			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773
<b>Syracuse 41:05:46 Lat 112:03:27 Long</b>			
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
1.0 sec SA	0.8321668	1.549357	2.842664
<b>Centerville 40:55:36 Lat 111:53:10 Long</b>			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773
<b>Kaysville 41:01:50 Lat 111:56:40 Long</b>			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307
<b>West Bountiful 40:90:03 Lat 111:90:22 Long</b>			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773

<b>Clearfield 41:06:16 Lat 112:01:21 Long</b>			
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
1.0 sec SA	0.8321668	1.549357	2.842664
<b>Layton 41:04:41 Lat 111:57:16 Long</b>			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307
<b>West Point 41:07:17 Lat 112:05:49 Long</b>			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
<b>Clinton 41:08:28 Lat 112:03:45 Long</b>			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
<b>Woods Cross 40:52:25 Lat 111:54:43 Long</b>			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
<b>North Salt Lake 40:50:40 Lat 111:55:22 Long</b>			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486

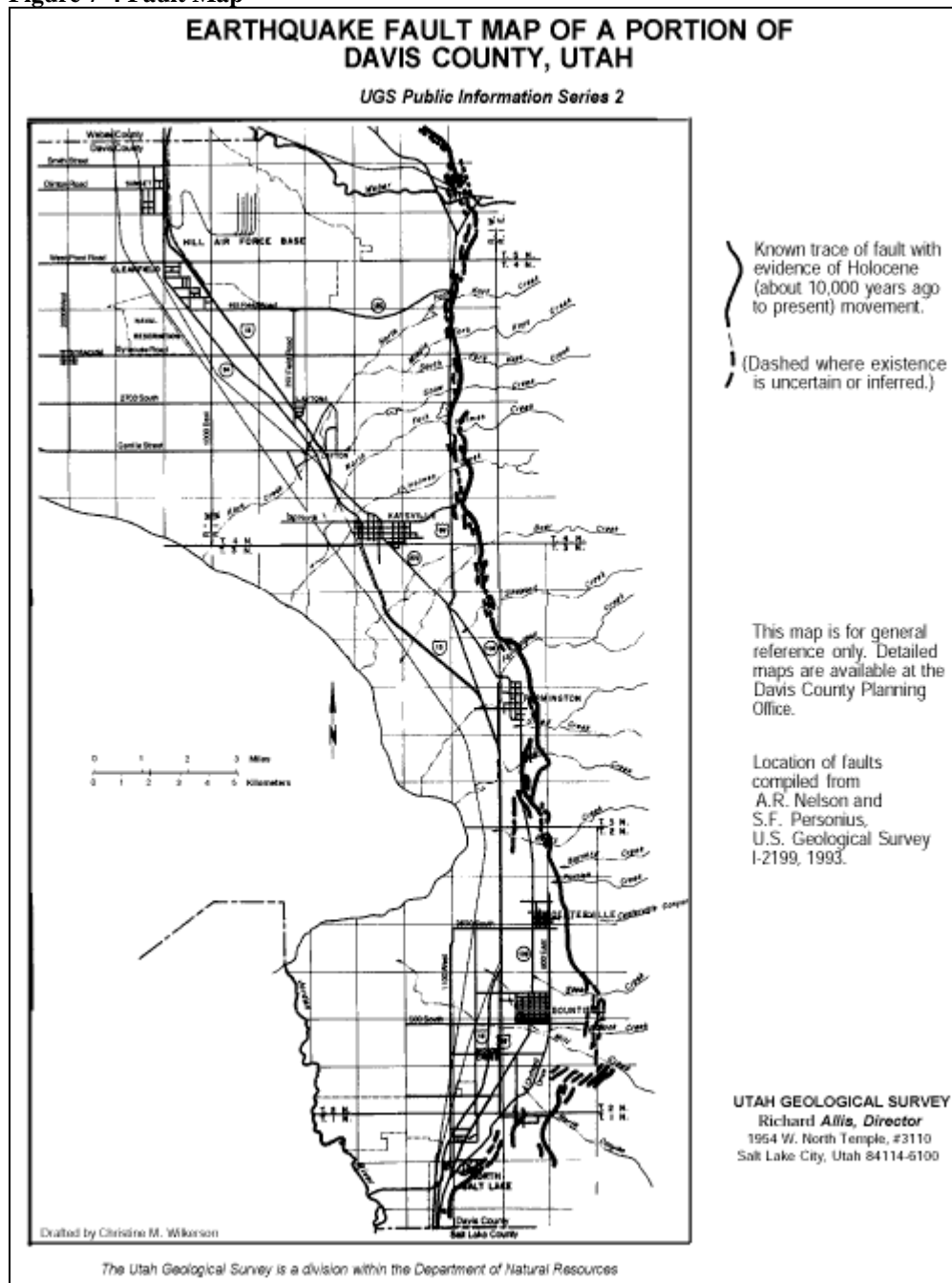
Liquefaction Potential is one of the secondary hazards associated with an earthquake and affects nearly the entire county. Davis County is located atop an ancient lakebed, Lake Bonneville, which is made up of unconsolidated sandy soils. The area is also subject to shallow ground water and a relatively high earthquake threat. For a further explanation of liquefaction see Figure 7-3 Davis County Liquefaction Potential. The regional hazard identification section also explains liquefaction in a narrative form. Figures 7-5 and 7-6 recognize the fault zones within Davis County.

Figure 7-3 Davis County Liquefaction Potential



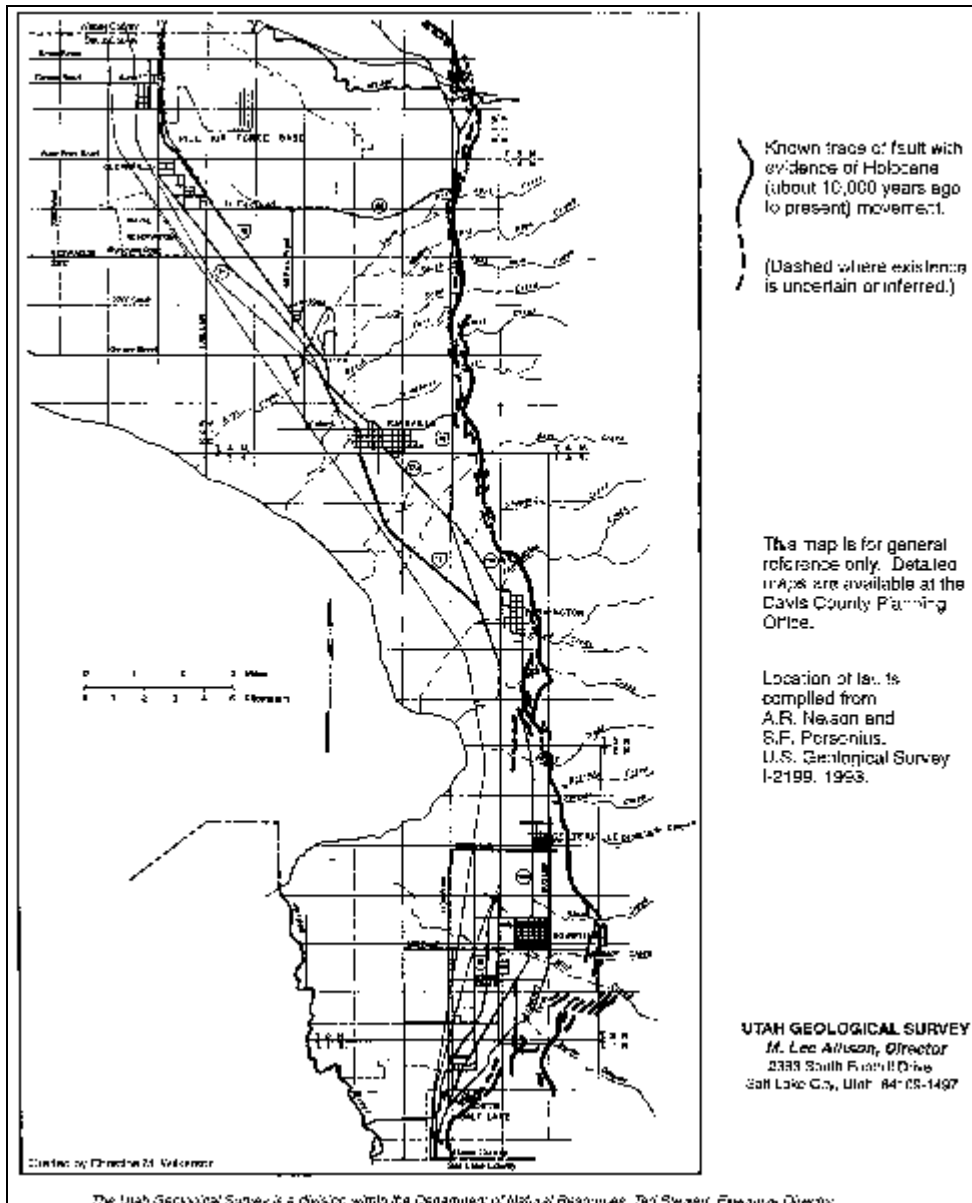
Source: Utah Geological Survey. Geologic Hazards- Liquefaction. 2003. State of Utah  
<<http://geology.utah.gov/online/images/pi-27.gif>>.

**Figure 7-4 Fault Map**



Source: Earthquake Fault Map of a Portion of Davis County. Utah Geological Survey. Public Information Series 2. Richard Allis. 2003. < <http://geology.utah.gov/online/images/pi-2.gif>>. 1997.

Figure 7-5 Fault Map 2



Source: Davis County Fault Map. University of Utah Seismograph Station. Utah Geological Survey. M. Lee Allison. 2003. < <http://geology.utah.gov/online/images/pi-2.gif>>. 1993.

### Vulnerability Analysis

The vulnerability analysis includes the type and number of residential, commercial, and critical facilities located in the earthquake hazard area (Tables 7-3, 7-4, 7-5 7-6, 7-7).

<b>Table 7-3 Vulnerability Assessment for Earthquake</b>									
City Name	City Area	Acres in Fault Zone	Acres in Liquefaction Zone	Number of property structures within Fault Zones		Number of Structures within Liquefaction Zones		Population in Hazard Areas	
				Residential/ Value	Commercial /Annual Sales	Residential/ Value	Commercial /Annual Sales	Earthquake	Liquefaction
Bountiful City	8,014	1345	817	2,113 / \$335,385,291	87/ \$53,900,000	2,387 / \$243,576,110	1,516/ \$1,534,200,000	6,659	8,264
Centerville City	3,796	95	3,092	136 / \$21,707,622	3/ \$800,000	4,315 / \$505,598,880	449/ \$503,400,000	431	12,799
Clearfield City	4,778	0	4,358	0	0	9,802 / \$1,188,913,986	519/ \$660,400,000	0	29,407
Clinton City	3,574	0	3,574	0	0	4,433 / \$743,266,060	147/ \$169,200,000	0	13,965
Farmington City	4,891	3,016	4,343	1,801 / \$285,875,794	137/ \$316,100,000	4,279 / \$495,122,610	310/ \$438,300,000	5,676	12,007
Fruit Heights	1,423	15	1,206	0	0	1,985 / \$337,556,250	69/ \$57,600,000	0	6,354
Kaysville	6,397	375	6,361	31 / \$5,154,095	1/ \$500,000	7,905 / \$1,304,325,000	595/ \$639,200,000	100	23,715
Layton	13,243	596	11,410	732 / \$118,956,518	14/ \$7,700,000	17,326 / \$2,750,455,556	1,693/ \$2,586,100,000	2,308	55,444
North Salt Lake	5,282	1,403	3,176	139 / \$22,250,192	130/ \$574,100,000	621 / \$33,875,220	584/ \$1,505,300,000	439	2,236
South Weber	3,045	537	256	420 / \$67,105,363	8/ \$3,900,000	156 / \$16,339,020	79/ \$82,100,000	1,324	732
Sunset City	930	0	776	0	0	1,623 / \$272,575,150	136/ \$122,200,000	0	5,195
Syracuse City	5,432	0	5,432	0	0	3,190 / 534,963,000	170/ \$201,500,000	0	9,889
West Bountiful	1,399	0	1,399	0	0	1,474 / \$150,053,160	215/ \$218,000,000	0	4,988
West Point	4,368	0	4,368	0	0	2,474 / \$417,971,180	258/ \$517,400,000	0	7,424
Woods Cross	2,194	1,254	1,916	604 / \$96,451,289	111/ \$125,300,000	2,144 / \$192,654,120	295/ \$389,200,000	1,903	5,119

\*Liquefaction for high to moderate zones.

\*City Area includes the total number of acres.

\*Value is replacement value.

\*0 indicates no information at this time to due lack of data or no known risk.

**Table 7-4 Critical Facilities within Fault Zones**

<b>Name</b>	<b>City</b>
<b>Oil Facilities</b>	
Big West Oil Company	N Salt Lake
Chevron USA Products Company	Salt Lake City
<b>Fire Stations</b>	
South Davis Fire District	North Salt Lake
Farmington City Fire Dept	Farmington
<b>Police Stations</b>	
North Salt Lake City Police	North Salt Lake
Centerville Police Dept	Centerville
Farmington Police Dept	Farmington
<b>Schools</b>	
Layton Christian Academy	Layton
Achiever Preschool/Kindergarten	Bountiful
Kinder Care	Centerville
Sunrise Montessori	Bountiful
Adelaide School	Bountiful
H C Burton School	Kaysville
Centerville Jr High	Centerville
Centerville School	Centerville
Farmington School	Farmington
Holbrook School	Bountiful
J A Taylor School	Centerville
Leo J Muir School	Bountiful
Monte Vista School	Farmington
Oak Hills School	Bountiful
Orchard School	North Salt Lake
Tolman School	Bountiful
Transition High	Farmington
Weber Basin Job Corps	Ogden
Stewart School	Centerville
Morgan School	Kaysville
East Layton School	East Layton
Farmington Jr High	Farmington
Mueller Park Jr High	Bountiful
Reading School	Centerville

**Table 7-5 Critical Facilities in Liquefaction Areas**

<b>Name</b>	<b>City</b>
<b>Communication Facility</b>	
KANN 1120	Roy
KWLW 700	North Salt Lake City
KWLW 700	North Salt Lake City
KSGO 1600	Centerville
<b>Waste Water Facility</b>	
Central Davis County Sewer District	Kaysville
North Davis County Sewer District	Syracuse
South Davis Sewer Improvement District N	West Bountiful
<b>Oil Facility</b>	
Big West Oil Company	N Salt Lake
Chevron USA Products Company	Salt Lake City
Cowboy Asphalt Terminal	Woods Cross
K West Formerly Golden Eagle Refinery	Woods Cross
Phillips 66 Company	Woods Cross
Silver Eagle Refining-Woods Cross Inc	Woods Cross
<b>Electric Power Facility</b>	
Bountiful City Light & Power	Bountiful
<b>Medical Facility</b>	
Davis Hospital & Medical Ctr	Layton
Benchmark Behavioral Systems	Woods Cross
<b>Fire Station</b>	
Syracuse City Fire Dept	Syracuse
Clinton City Fire Dept	Clearfield
Layton Fire Dept	Layton
West Point Fire Dept	Clearfield
Farmington City Fire Dept	Farmington
Sunset Fire Dept	Clearfield
Clearfield Fire Dept	Clearfield
<b>Police Station</b>	
Woods Cross Police	Woods Cross
Syracuse City Police Dept	Syracuse
Clinton City Police Dept	Clearfield
Centerville Police Dept	Centerville
Clearfield Police Dept	Clearfield
West Bountiful Police Dept	Woods Cross
Kaysville Police Dept	Kaysville

West Point City Police Dept	Farmington
Farmington Police Dept	Farmington
Sunset Police Dept	Clearfield
<b>Schools</b>	
Benchmark School	Woods Cross
Kinder Care	Centerville
School Of St Peter	Clearfield
T.L.C. Preschool And Kindergarten	Layton
Northridge High	Layton
Bountiful Jr High	Bountiful
H C Burton School	Kaysville
Centerville Jr High	Centerville
Centerville School	Centerville
Central Davis Jr High	Layton
Clearfield High	Clearfield
Clinton School	Clinton
Crestview School	Layton
Davis High	Kaysville
Pioneer Adult Rehab Center	Clearfield
Doxey School	Sunset
King School	Layton
Farmington School	Farmington
Fremont School	Sunset
Hill Field School	Clearfield
J A Taylor School	Centerville
Kaysville Jr High	Kaysville
Kaysville School	Kaysville
Layton High	Layton
Layton School	Layton
Lincoln School	Layton
Meadowbrook School	Bountiful
Monte Vista School	Farmington
North Davis Jr High	Clearfield
North Layton Jr High	Layton
Woods Cross School	Woods Cross
South Clearfield School	Clearfield
Sunset Jr High	Sunset
Sunset School	Sunset
Syracuse School	Syracuse
Tolman School	Bountiful
Viewmont High	Bountiful
Wasatch School	Clearfield
West Bountiful School	West Bountiful
West Point School	West Point
Whitesides School	Layton

Fairfield Jr High	Kaysville
Windridge School	Kaysville
Lifeline	N Salt Lake
Davis Jr High	Kaysville
Farmington Bay Youth Ctr	Farmington
Transition High	Farmington
Clearfield Job Corps	Clearfield
Trident School (Drug & Alcohol)	Layton
Arrow High (Yic)	Clearfield
Creekside School	Kaysville
Bluff Ridge School	Syracuse
Lakeside School	West Point
Stewart School	Centerville
Quest Program (Yic)	Layton
Cook School	Syracuse
Morgan School	Kaysville
East Layton School	East Layton
Holt School	Clearfield
Knowlton School	Farmington
Columbia School	Kaysville
Farmington Jr High	Farmington
Adams School	Layton
Reading School	Centerville
Mountain High	Kaysville
Young Parents	Kaysville
Syracuse Jr High	Syracuse
Antelope School	Clearfield
West Clinton School	Clinton
<b>Emergency Center</b>	
Civil Defense	Farmington

**Table 7-6 Infrastructure in Earthquake Area**

Item	Length (Miles)	Replacement Cost
Local Roads	5.31	\$10,617,200
State Highways	14.84	\$35,811,996
US Highways	10.10	\$24,373,695
US Interstates	9.68	\$34,863,840
Power Lines	26.24	\$1,266,867
Gas Lines	15.03	\$3,628,092

**Table 7-7 Infrastructure in Liquefaction Area**

Item	Length (Miles)	Replacement Cost
Local Roads	18.03	\$36,060,000
State Highways	64.77	\$156,320,464
US Highways	9.56	\$23,068,233
US Interstates	25.55	\$91,962,000
Power Lines	265.51	\$12,818,823
Gas Lines	41.89	\$10,111,827

**HAZUS MH Vulnerability Assessment**

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 7-8 identifies the probable casualties during an earthquake.

**Table 7-8 Casualties**

Casualties	Nighttime –Minor	3,402
	Nighttime –Major	95
	Nighttime -Fatalities	183
	Daytime –Minor	3,718
	Daytime –Major	146
	Daytime- Fatalities	281
	Commute –Minor	3,549
	Commute –Major	129
	Commute-Fatalities	243

### Building Damage by Count

Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 7-9 lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage. Table 7-10 identifies the critical facilities that would be affected by an earthquake.

**Table 7-9 Building Damage by Count with Moderate to Complete Damage**

Category	Number of Structures
Residential	4,343
Commercial	485
Industrial	62
Totals	44,344*

\*Includes all building categories with moderate to complete damage

**Table 7-10 Critical facilities**

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	3	3	0	0
Schools	91	86	0	0
EOCs	1	0	0	1
Police Stations	14	12	0	0
Fire Stations	11	9	0	0

### Debris Removal

Table 7-11 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

**Table 7-11 Debris Generated (millions of tons)/Loads to Remove Debris**

Debris Generated	2
Loads (25 tons per load)	80,000

### Fire Following

The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 7-12 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

**Table 7-12 Fire Following Event, Population Exposed, and Building Stock Exposed**

Ignitions	26
People Displaced	698
Value Exposed (mill. \$)	34

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

Please refer to Map 7.1.1 titled, Davis County Earthquake Hazard located in section H. This map identifies earthquake epicenter and fault zone locations atop a shaded relief base map to help distinguish topography. Map 7.1.2 identifies liquefaction potential for Davis County and is also found in section H.

## 2. Flood

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

### Description of Location and Extent

Historically, the greatest flood risk within Davis County has been associated with cloudburst storms that generally result in flash flooding in localized areas. Heavy rain and rapid snowpack melt can also result in unusually heavy water, and/ or mud and debris flows. Davis County's precipitation is associated with the Wasatch Mountain Range, which is where most of the County's surface water originates. All of the streams originate in canyons and pass along alluvial fans, across the eastern portion of the county into the Great Salt Lake.

The two major rivers that pose a flood threat include the Weber and Jordan Rivers. The Weber River acts as a partial northern county boundary, while the Jordan River is the southern boundary. Many smaller tributaries also pose a flood threat, however, they are not mapped through the NFIP. Many channels within the county can pose a threat due to channel constrictions from debris and could result in residential flooding. All of the alluvial fans in the county have been well developed or on being developed and therefore potential residential and commercial flooding is imminent. Flood can also pose a threat to the agricultural lands that are on the lower portions of the alluvial fans.

A little more than 50% of the county is under the Great Salt Lake. This results in a very high ground water table for the county and poses a flooding threat to the shorelines and in some cases to agricultural lands and roads. Flooding in wetlands areas, along the shores of the Great Salt Lake, also threatens urban development.

High stream flows and velocity can affect the residential, commercial, and recreational development on Farmington Creek, Kays Creek, Ricks Creek, and Steeds Creek. Roads can be affected from high stream flows on Barton Creek, and Holmes Creek. The primary threatened utilities are power substations and water treatment plant located on Stone Creek, Farmington Creek, Holmes Creek, and Millcreek. In 1983 Rudd Creek experienced a debris flow that put the city of Farmington on the contaminated water supply list.

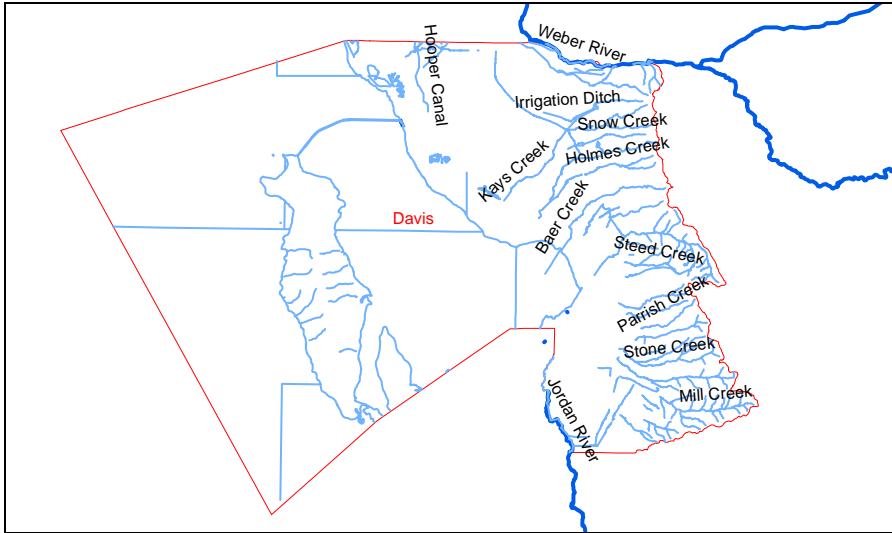
County flood control has a number of projects in progress and planned for the next few years. These are in existing creek beds throughout the county. They spend over \$1 million yearly in maintenance and new projects.

### Vulnerability Assessment

At this time, a Vulnerability Assessment was unable to be performed due to the lack of digitized floodplain maps and datasets used to conduct the assessments for the other natural hazards that affect the county.

However, current mapping projects are being completed by the State that will result in better data and therefore a greater understanding of risk. The county would like to continue to work with the state to understand their threats; therefore general mitigation goals have been included. A Flood Hazard Identification Study has also been compiled by the Army Corps of Engineers in 2003, this study can be found in Appendix G. Also, refer to the “Centerville City Pre-Disaster Flood Hazard Mitigation Plan” for an idea of the flood hazard issues and mitigation activities for Centerville City.

**Figure 7-6**



### 3. Wildfire

#### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

#### Description of Location and Extent

Potential wildfire hazard within Davis County is growing as population growth is spreading into wildland areas known as URWIN zone where the threat is most severe. Over the past 30 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property. Most fires can be contained in a quarter-acre to one-acre area if they have not traveled into the wildland zones higher in the mountains, which are harder to fight due to steep mountain terrain.

The wildfire threat in Davis County in the past has had a significant affect on the watersheds, including slope failure, debris flows, and other forms of erosion. State and local agencies have worked together to enforce ordinances and other programs such as re-vegetation zones to protect watersheds.

Wildfire maps were created using GIS and can be viewed in Section H Map 7.3.1 Davis County Wildfire Risk. The map layers were provided by DESHS and show five categories of wildfire risk:

- Extreme
- High
- Medium
- Low
- Very Low

These ratings cover all of Davis County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

#### Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population within each of the areas is also included (Table 7-13). There are no critical facilities in Davis County that are located in the Wildfire risk areas of extreme, high, or medium. Table 7-14 lists infrastructure affected by wildfire, and Table 7-15 lists historical wildfires in Davis County.

**Table 7-13 Structures and Population in Wildfire Area**

City Name	City Area (Acres)	Acres in Extreme	Acres in High	Acres in Moderate	Number of Structures within Wildfire Risk Area		Population in Hazard Areas
					Commercial/ Annual Sales	Residential/ Replacement Value	
Bountiful City	8,014	53	123	2,330	148/ \$123,900,000	1,398/ \$310,808,250	2,860
Centerville City	3,796	7	20	51	7 / \$4,000,000	79 / \$16,551,180	252
Clearfield City	4,778	0	0	0	0	0	0
Clinton City	3,574	0	0	0	0	0	0
Farmington City	4,891	21	41	173	2/ \$200,000	270 / \$41,131,950	617
Fruit Heights	1,423	0	39	60	2/ \$9,000,000	17 / \$4,527,910	61
Kaysville	6,397	0	68	139	1 / \$100,000	65 / \$10,853,180	195
Layton	13,243	75	54	413	55 / \$78,800,000	333/ \$58,199,490	1,569
North Salt Lake	5,282	12	127	748	37 / \$19,300,000	1137 / \$227,959,440	3,124
South Weber	3,045	0	120	308	61/ \$56,000,000	18 / \$2,130,660	69
Sunset City	930	0	0	0	0	0	0
Syracuse City	5,432	0	0	0	0	0	0
West Bountiful	1,399	0	0	0	0	0	0
West Point	4,368	0	0	0	0	0	0
Woods Cross	2,194	0	0	0	0	0	0

**Table 7-14 Infrastructure in Wildfire Area**

Item	Length (Miles)	Replacement Cost
Local Roads	1.17	\$2,330,600
State Highways	1.03	\$2,488,319
US Highways	1.81	\$4,372,538
US Interstates	3.61	\$12,990,600
Power Lines	7.94	\$383,343
Gas Lines	9.29	\$2,242,513

**Table 7-15 Wildfire History**

<b>Date</b>	<b>Fire Name</b>	<b>Cause</b>	<b>Size</b>
6/14/84	Antelope # 1	Lightning	300 – 999 Acres
6/9/90	Antelope Island # 1	Lightning	1000 – 4999 Acres
6/24/90	Antelope Island # 2	Lightning	>5000 Acres
7/14/91	Antelope # 1	Lightning	1000 – 4999 Acres
6/4/94	Buffalo Point	Incendiary	1000 – 4999 Acres
7/6/01	Aisp4	Lightning	1000 – 4999 Acres

## 4. Landslide/ Slope Failure

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

### Description of Location and Extent

Future landslide areas are usually located in the areas of historical landslides, which are well defined, localized areas. Historically landslides have been one of the most naturally re-occurring hazards within Davis County found along canyon benches. The homes in these areas have the greatest risk of rockfalls, debris flows, landslides, and other types of slope failure.

Debris flows associated with ground saturation and runoff has been a major problem in Davis County. Many of the alluvial fans at the mouths of Davis County's fifteen canyons have been developed. This development is vulnerable due to the debris flows and flash flooding associated with the alluvial fans. Ten of the fifteen canyons have enforced structural mitigation through the use of debris and detention basins. The protected canyons include Mill Creek- 2 debris basins, Barton Creek -1 debris basin, Stone Creek – 1 debris basin, Parish Creek –1 debris basin, Ricks Creek -1 debris basin, Steed Creek –1 debris basin, Farmington Creek -1 debris basin, Shepherd Creek -1 debris basin, Baer Canyon - 1debris basin, South Fork of Holmes Creek - 1debris basin. The unprotected canyons include Deuel Creek, Barnard Creek, Davis Creek, Snow Canyon, North, South, and Middle Forks of Kays Creeks. Many homes are built on alluvial fans and the need for more detention basins and the upgrade of existing basins is needed.

Davis County and local jurisdictions recognized the need to protect alluvial fans from slope failure. Davis County has made progress in the past by becoming Utah's first Project Impact Community to help mitigate the Centerville Canyon alluvial fan and Barnyard Creek alluvial fan.



Landslide in Layton. Picture provided by American Geological Institute.

### Vulnerability Assessment

The number of residential structures contained within the landslide hazard risk may capture more or less structures than are actually at risk from landslides. In order to accurately capture landslide risks in these areas an assessment has been conducted using parcel data that identifies the people and property at risk including critical facilities (Table 7-16 and 7-17). Table 7-18 lists infrastructure affected by landslide and includes estimated replacement costs.

Refer to the Landslide Map 7.4.1 titled, Davis County Landslide Hazard at the end of this section for historical events and locations.

**Table 7-16 Inventory of Properties Located in High Landslide Risk Areas**

City Name	City Area (Acres)	Within Landslide Area		Number of property structures within Landslide Area	
		Acres	Population	Commercial/ Annual Sales	Residential/ Replacement Value
Bountiful City	8,014	1,345	6,659	87 / \$53,900,000	1,925 / \$338,578,680
Centerville City	3,796	95	431	3 / \$800,000	67 / \$8,073,230
Clearfield City	4,778	0	0	0	0
Clinton City	3,574	0	0	0	0
Farmington City	4,891	3,016	5,676	137 / \$316,100,000	1,666 / \$199,841,910
Fruit Heights	1,423	15	0	0	0
Kaysville	6,397	375	100	1 / \$500,000	25 / \$3,824,930
Layton	13,243	596	2,308	14 / \$7,700,000	252 / \$36,184,640
North Salt Lake	5,282	1,403	439	130/ \$574,100,000	103 / \$15,856,120
South Weber	3,045	537	1,324	8 / \$3,900,000	18 / \$2,188,590
Sunset City	930	0	0	0	0
Syracuse City	5,432	0	0	0	0
West Bountiful	1,399	0	21	0	0
West Point	4,368	0	0	0	0
Woods Cross	2,194	1,254	1,903	111 / \$125,300,000	994 / \$95,600,220

**Table 7-17 Critical Facilities within Landslide Risk Areas**

<b>Name</b>	<b>City</b>
<b>Oil Facility</b>	
Cowboy Asphalt Terminal	Woods Cross
K West Formerly Golden Eagle Refinery	Woods Cross
<b>Police Department</b>	
West Point City Police Department	West Point
<b>Schools</b>	
Centerville School	Centerville
Farmington School	Farmington
Oak Hills School	Bountiful
Farmington Bay Youth Ctr	Farmington
Knowlton School	Farmington
Mueller Park Jr High	Bountiful
<b>Emergency Center</b>	
Civil Defense Emergency Center	Farmington

**Table 7-18 Infrastructure and Landslide Area**

<b>Item</b>	<b>Length (Miles)</b>	<b>Replacement Cost</b>
Local Roads	0.80	\$1,600,200
State Highways	9.37	\$22,611,599
US Highways	2.32	\$5,597,631
US Interstates	2.71	\$9,744,840
Power Lines	5.40	\$260,712
Gas Lines	11.95	\$2,884,611

## F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Included in Table 7-19 are hazard events with as much relevant information as was available including date, location, area impacted, and damage costs.

**Table 7-19 Hazard History**

<b>Hazard</b>	<b>Date</b>	<b>Location</b>	<b>Critical Facility/ Area Impacted</b>	<b>Comments</b>
Avalanche	01/25/1860	Centerville Canyon		One death
Flooding	08/13/1923	Farmington Canyon	Lagoon Resort was flooded. Farmington Canyon road was destroyed.	Farming land was destroyed, residential property and roads covered in mud
Avalanche	01/01/1939	Farmington Canyon		One death
Avalanche	01/31/1939	Farmington Canyon		One death
Tornado	05/27/1941		Farmington Canyon towards Morgan County	F2. \$4,000-\$5,000 in damage.
Flooding	08/05/1948	Bountiful	Flooding in business and residential areas.	Thousands of dollars of residential damage.
Tornado	06/05/1953			F1
Flooding	08/1-2/1953	Clearfield	Streets and homes flooded	
Flooding	08/04/1954	Bountiful		Damage to residential property.
Earthquake	05/12/1955	Centerville		Richter magnitude 4.3
Flooding	05/20/1957	Bountiful/ Farmington	Stone Creek	Homes flooded from high water.
Flooding	08/25/1961	Bountiful	US 91 covered with water and debris.	Streets and homes flooded.
Flooding	06/01/1963	Farmington		Cloudburst storm flooded homes and streets.
Tornado	06/03/1963	Bountiful		F2. At least \$20,000 in damage.
Earthquake	06/20/1963	Kaysville		Richter magnitude 3.0
Flooding	06/24/1969	Bountiful		Business losses and orchard losses.
Tornado	06/10/1970		Between Centerville and Farmington	F1
Lightning	07/11/1976	Hill Air Force Base		One death.

Flooding	1983-1984	Statewide		Major damage to all infrastructure.
Waterspout	08/15/1987			
Tornado	05/11/1989		Runway of Hill Air Force Base	F0
Waterspout	11/26/1989			
Tornado	09/23/1992	Syracuse		F1. \$1500 in damage.
Tornado	06/02/1993	North Salt Lake		F1. Two injuries. \$15000 in damage.
Tornado	07/29/1995	Centerville		F0. More than \$10000 in damage.
Tornado	05/29/1996	Syracuse		F0. Minor residential damage.
Tornado	05/21/1998	West Point		F0. No injuries.
Tornado	06/04/1998	Layton		F1. Over \$25000 in damage.
Landslide	2001	Heather Drive		Destroyed six homes. Over \$1 million in damage.

## G. Mitigation Goals, Objectives, Actions

**Davis County Emergency Management**  
**Brian Law**  
Emergency Services Coordinator

County: Davis  
Address: 20 East State Street  
City: Farmington  
Zip Code: 84025

Point of Contact: Sgt. Brian Law  
Email: brianlaw@co.davis.ut.us

Signature: \_\_\_\_\_  
County/Tribal Emergency Management Director

### Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group

Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

Members of the County/Tribal PDM Working Group:

Name: <u>Brian Law</u>	Title: <u>County Emergency Services Coordinator</u>
Name: <u>Dave Adamson</u>	Title: <u>Public Works Director – Davis County</u>
Name: <u>Dustin Lewis</u>	Title: <u>Centerville City Emergency Services</u>
Name: <u>John Thacker</u>	Title: <u>Kaysville City Manager</u>
Name: <u>Walt Hokanson</u>	Title: <u>Farmington City Public Works</u>
Name: <u>Norm Whitaker</u>	Title: <u>West Point City Public Works</u>
Name: <u>Anne Blankenship</u>	Title: <u>Woods Cross City Emergency Services</u>
Name: <u>Farrell Cook</u>	Title: <u>West Point City Councilman</u>
Name: <u>John Massengale</u>	Title: <u>South Weber City Councilman</u>
Name: <u>Jim Mason</u>	Title: <u>Layton City Emergency Services</u>

### Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s)

Attach additional information as needed.

Date: 11-20-2003  
Time: 1000 hours  
Place: Davis County Sheriff's Office

### Purpose of Meeting:

Determine Projects for Pre-Disaster Mitigation in Davis County

Name: <u>Brian Law</u>	Title: <u>County Emergency Services Coordinator</u>
Name: <u>Floyd Peterson</u>	Title: <u>Fire Chief – Clinton City</u>
Name: <u>Larry Gregory</u>	Title: <u>Fire Chief – Farmington City</u>
Name: <u>Lt. Kirk Middaugh</u>	Title: <u>Section 3 Commander – DPS/UHP</u>
Name: <u>Dave Adamson</u>	Title: <u>Public Works Director – Davis County</u>
Name: <u>Lt. Paul Child</u>	Title: <u>Centerville City Emergency Services</u>
Name: <u>Dustin Lewis</u>	Title: <u>Centerville City Emergency Services</u>

Name: <u>John Thacker</u>	Title: <u>Kaysville City Manager</u>
Name: <u>Walt Hokanson</u>	Title: <u>Farmington City Public Works</u>
Name: <u>Bret Millburn</u>	Title: <u>Red Cross</u>
Name: <u>Norm Whitaker</u>	Title: <u>West Point City Public Works</u>
Name: <u>John Mabey</u>	Title: <u>Utah – Amateur Radio Emergency Services</u>
Name: <u>Anne Blankenship</u>	Title: <u>Woods Cross City Emergency Services</u>
Name: <u>Farrell Cook</u>	Title: <u>West Point City Councilman</u>
Name: <u>John Massengale</u>	Title: <u>South Weber City Councilman</u>
Name: <u>Jim Mason</u>	Title: <u>Layton City Emergency Services</u>

### **Summary of Meeting:**

The five hazard areas determined to require most mitigation at this time are: Earthquake, Wildfire, Flooding, Landslide, and Severe Weather. Ideas were given as to projects that could be launched to mitigate loss of life and property within each of these areas. General goals were established for each category.

### **Outcome(s) of Meeting:**

A pre-disaster mitigation plan will be established using the information obtained from the meeting mentioned above. When funding allows, projects will be ensued.

### **Develop Mitigation Goals and Objectives**

Developing strong mitigation goals and objectives are crucial in the planning process and future mitigation project funding. In coordination with the Regional AOG planner(s), and your County/Tribal PDM Working Group, list your County's/Tribal/Region mitigation strategies using the following format:

Note: Countywide in this document refers to a mitigation strategy benefiting the cities of: Bountiful, Centerville, Clearfield, Clinton, Farmington, Fruit Heights, Kaysville, Layton, North Salt Lake, South Weber, Sunset, Syracuse, West Bountiful, West Point, and Woods Cross.

### **Hazard: Earthquake**

#### **Problem Identification:**

Davis County is located in the heart of the Wasatch Fault between the shores of the Great Salt Lake and the foothills of the Wasatch Mountain Range. The majority of the population lives within 5 miles of the fault. The only major traffic artery running north and south, and numerous water and petroleum pipelines either cross over or run within ½ mile of the fault. 5 moderately sized petroleum refineries located in the south end of the county are subject to severe damage from ground movement and liquefaction. A major earthquake in the area would result in 100's of millions of dollars in damage to residential structures, industry, and of critical infrastructure, not to mention some loss of life.

#### **Goal #1:**

Reduce loss of life and limit damage to property.

#### **Objective 1.1: Priority HIGH**

Provide education on seismic hazards and mitigation, to Davis County residents and homeowners.

#### **Action:**

Public Education

Time Frame: Immediate

Funding: LEPC

Estimated Cost: \$2500.00

Staff: LEPC Membership

Jurisdictions: Countywide

Background: Provide information to residents and business owners to encourage them to take appropriate measures to make homes and businesses less susceptible to damage from

ground shaking. Education pertaining to earthquakes will be part of a holistic natural hazards education program, including wildfires, flooding, severe weather, and landslides.

**Objective 1.2: Priority MEDIUM**

Increase quality and quantity of available natural hazards data to facilitate better decision-making.

**Action:**

Update fault zone and liquefaction maps for the county

Time frame: Two years

Funding: Undetermined, potentially USGS or UGS

Estimated Cost: Minimal

Staff: USGS Staff

Jurisdictions: Countywide

Background: Provide updated, detailed maps to city and county planning groups, emergency managers, and public to assist them in making educated decisions by understanding earthquake danger zones.

**Problem Identification:**

A number of critical structures, which contain fire apparatus within the county do not meet current building criteria and could sustain considerable damage or suffer total destruction from ground shaking. These buildings exist in Clinton, South Weber and Layton.

**Goal #2:**

Protect emergency response capabilities and critical facilities.

**Objective 2.1: Priority HIGH**

Provide fire department with building that meet current construction codes, ensuring response capability of fire apparatus and personnel after an earthquake.

**Action:**

Retrofit or construct new fire department buildings

Time Frame: 4 Years

Funding: Grants and city budgets

Estimated Cost: \$8 million

Staff: Contract

Jurisdictions: Countywide, targeting Clinton City, South Weber, and Layton City.

Background: Refer to "Clinton City Fire Station Structural Analysis" for more information regarding the vulnerability assessment of the Clinton City fire station.

**Hazard: Wildland Fire**

**Problem Identification:**

Much of the inhabitable land within Davis County is on the east bench. Numerous homes and subdivisions have been and are being constructed in these areas. Many of these structures border the Forest Service boundary or are in areas of old scrub oak growth. The potential for catastrophic damage from wildfire increases yearly.

**Goal #1**

Reduce or eliminate the threat of a wildfire, resulting in loss of life and property.

**Objective 1.1: Priority HIGH**

Increase the level of wildfire knowledge for home and business owners in the Urban Wildland Interface area.

**Action:**

Public awareness and education

Time Frame: Immediate

Funding: LEPC

Estimated Cost: \$0

Staff: LEPC membership, UFFSL, National Forest Service

Jurisdictions: Targeting county URWIN communities

Background: This project is part of a holistic natural hazard education campaign within Davis County. Wildfire education will instruct on the principles of defensible space in coordination with the Utah Living With Fire Committee. Homeowners in the foothills abutting the Wasatch National Forest, along with other identified URWIN communities will be targeted.

**Action:**

Provide wildfire training to city and county planning and zoning officials and staff.

Time frame: Immediate

Funding: LEPC

Estimated Cost: \$0

Staff: LEPC membership, UFFSL, DES, National Forest Service.

Jurisdictions: Countywide

Background: City and county planners need to understand issues related to wildland fire fighting, such as water and access, in order of properly plan for development of lands in the urban/wildland interface.

**Problem Identification:**

In much of the county, there is little, if any, natural break between wildland Forest Service areas and residential areas. There are some old roads and “fire breaks” that are in ill repair, or have not been maintained for years. They have become ineffective as fire breaks and hazardous to fire apparatus.

**Goal #2**

Fuel modification within prioritized watersheds.

**Objective 2.1: Priority HIGH**

Re-establish effective firebreaks.

**Action:**

Widen and stabilize the firebreak between Farmington Canyon and Bountiful.

Time Frame: Immediate

Funding: Grant, County budget, and Forest Service

Estimated Cost: \$200,000

Staff: County Public Works, Wasatch National Forest staff

Jurisdictions: Farmington, Bountiful, Centerville and unincorporated county developments along the Wasatch National Forest Boundary.

Background: This project is already in the planning stage. As funding is confirmed the project will commence.

**Action:**

Widen and stabilize the firebreak north of Farmington Canyon to the Weber River.

Time frame: 2 Years

Funding: Grants, County Budget, and Forest Service

Estimated Cost: \$500,000

Staff: County Public Works, Wasatch National Forest staff.

Jurisdictions: Farmington, Fruit Heights, and unincorporated county development along the Wasatch National Forest Boundary.

Background: This area is considerably longer, but is almost entirely within existing forest service boundaries. This may result in a less aggressive project; however, some widening and stabilization can be accomplished.

## **Hazard: Flooding**

### **Problem Identification:**

The potential for flooding due to spring runoff, and especially from summer thunderstorms, is high in certain areas of the county. Existing flood plain maps do not indicate areas of flooding potential that exist, in large part due to development, that are not near creeks and the Great Salt Lake. Also not addressed is the Weber Basin Irrigation Water Aqueduct and canals that are a potential source of flooding.

### **Goal #1**

Reduce or eliminate loss of life and property damage due to flooding.

#### **Objective 1.1: Priority HIGH**

Increase the level of understanding in homeowners through education programs.

##### **Action:**

Public education and awareness.

Time Frame: Immediate

Funding: LEPC

Estimated Cost: \$0

Staff: LEPC Membership

Jurisdictions: Countywide

Background: This information and awareness campaign will be part of a holistic education campaign addressing the all-natural hazards, which will include all Davis County residents.

#### **Objective 2.1: Priority HIGH**

Reduce loss of life and property damage due to flooding by providing current building code and NFIP maps to cities.

##### **Action:**

Encourage city planners to update building codes.

Time Frame: Immediate

Funding: None

Estimated Cost: 0

Staff: LEPC members

Jurisdictions: Countywide

Background: There is evidence that not all cities in the county use updated code information concerning building of home and other structures in areas prone to flooding.

##### **Action:**

Update the county flood plain maps and include contour lines.

Time frame: One year

Funding: Federal Grants

Estimated Cost: Unknown

Staff: State DES, county personnel

Jurisdictions: Countywide

Background: Based on federal funding State DES in planning to start a flood plain map revision and update process this coming year. With cooperation from the county, we will request contour lines be added to these maps to give a realistic idea of where flooding may occur in other than historically flooded areas.

#### **Objective 2.2: Priority MEDIUM**

Lessen the impacts of flood damage caused by irrigation canal failure.

**Action:**

Inspect irrigation canals.

Time frame: 3 Years

Funding: Weber Basin Water District, Federal Grants

Estimated Cost:

Staff: Weber Basin Water District, Contractors

Jurisdictions: Communities with in Davis County down slope from Weber Basin

Irrigation pipeline

Background: Aging agriculture irrigation canals are prevalent throughout Davis county.

As farming lands is converted to residential and businesses the farming infrastructure remains, supplying water to remaining farmers. The canals can break inundating down slope property.

**Hazard: Landslide****Problem Identification:**

The east bench of Davis County is home to numerous canyons, large and small. They were, of course, formed over thousands of years by debris flows and mudslides. Now, many hundreds of homes and other structures, pipeline, power lines, and roadways have been constructed on top of or through the alluvial fans produced by these events. Nature is not done constructing these canyons. Landslides and debris flows will continue to occur over time, thus threatening residents and critical infrastructure.

**Goal 1**

Avoid risk or exposure to landslides through informed planning and zoning decisions.

**Objective 1.1: Priority HIGH**

Educating planning commissions.

**Action:**

Provide city-planning commissions with information concerning landslides and debris flows.

Time Frame: One Year

Funding: None

Estimated Cost: 0

Staff: LEPC members

Jurisdictions: Countywide

**Action:**

Encourage cities to adopt a standard of requiring geo-technical studies in identified landslide and debris flow areas.

Time frame: One Year

Funding: None

Estimated Cost: 0

Staff: LEPC members

Jurisdictions: Countywide

Background: The Utah Geologic Survey will review geology reports submitted to counties and cities when requested. Additional the UGS can aid in writing geologic hazard ordinances. The city of Layton in Davis County has adopted geologic ordinances.

**Problem Identification:**

There are a number of canyons that do not currently have debris basin constructed to contain debris flows. Others are insufficient in size. These need to be built or reconstructed in order to provide protection to residents. In addition, Weber Basin Water District maintains a large irrigation pipeline running from the mouth of Weber Canyon to east Bountiful. Any event that caused a break in the line would result in massive flooding due to the fact that there are no valves in the system.

## **Goal 2**

Reduce or eliminate landslide damage due to debris flows.

### **Objective 2.1: Priority MEDIUM**

Reduce loss of life and damage to property by providing a means to control debris and water from debris flows.

#### **Action:**

Construct additional Debris Basins and retrofit others.

Time Frame: 5 Years

Funding: Federal grants, County funding, City funding

Estimated Cost: \$10 million

Staff: County public works, city public works, contractors

Jurisdictions: Countywide developments and future developments on alluvial fans in Davis County.

Background: Barnard Creek and other projects yet to be determined.

### **Objective 2.2: Priority MEDIUM**

Lessen the impacts of flood damage caused by irrigation canal failure.

#### **Action:**

Place check valves in the Weber Basin irrigation pipeline.

Time frame: 3 Years

Funding: Weber Basin Water District, Federal Grants

Estimated Cost: \$400,000

Staff: Weber Basin Water District, Contractors

Jurisdictions: Communities with in Davis County down slope from Weber Basin

Irrigation pipeline

Background: Placing valves at strategic locations that can be automatically shut in the event of a break would result in less flood damage.

## **Hazard: Severe Weather**

### **Problem Identification:**

Most presidential disaster declarations are the result to severe weather. Davis County is prone to the affects of severe weather as are many other counties in the state. These are usually thunderstorms and snowstorms. However, we are also prone to extremely severe wind events referred to as "East Winds." Historically, Davis County has experienced gusts of over 110 mph and sustained winds of 80+ mph. These can result in millions of dollars in damage. On average we experience at least one every year. Severe storms result in secondary and tertiary problems mostly dealing with power, heating and travel. Davis County has only one main north/south roadway thru the county. Severe weather has resulted and will continue to result in serious travel problems, as well as power and heating difficulties.

## **Goal 1**

Assist residents protect themselves from the affects of severe weather.

### **Objective 1.1: Priority HIGH**

#### **Action:**

Have all cities in the county participate in the Storm Ready program.

Time Frame: 1 Year

Funding: City and county budgets

Estimated Cost: 1000.00

Staff: City and county Emergency Managers

Jurisdictions: Countywide

Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

**Action:**

Encourage avalanche preparedness for county backcountry users.

Time Frame: 1 Year

Funding: Minimal

Estimated Cost: Minimal

Staff: City and county Emergency Managers, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.

Jurisdictions: Countywide

Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual is more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Davis County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in their party. Thus, education can limit the number of avalanche related searches each year.

**Problem Identification:**

As mentioned above, high winds can result in serious problems throughout the county. Communications for emergency responders have been severely hampered in the past by damage to communication infrastructure.

**Goal 2**

Ensure severe weather communication

**Objective 2.1: Priority MEDIUM**

Harden communications capabilities to ensure post event functionality.

**Action:**

Reinforce towers and infrastructure

Time Frame: 2 Years

Funding: To be determined

Estimated Cost: To be determined

Staff: UCAN, city and county personnel

Jurisdictions: Countywide

**Action:**

Establish alert and notification procedures/system to notify emergency responders, flood control, and emergency managers.

Time frame: 1 Year

Funding: None

Estimated Cost: 0

Staff: Emergency Management

Jurisdictions: Countywide

Background: Set up alert and notification groups within UNIS and City Watch.

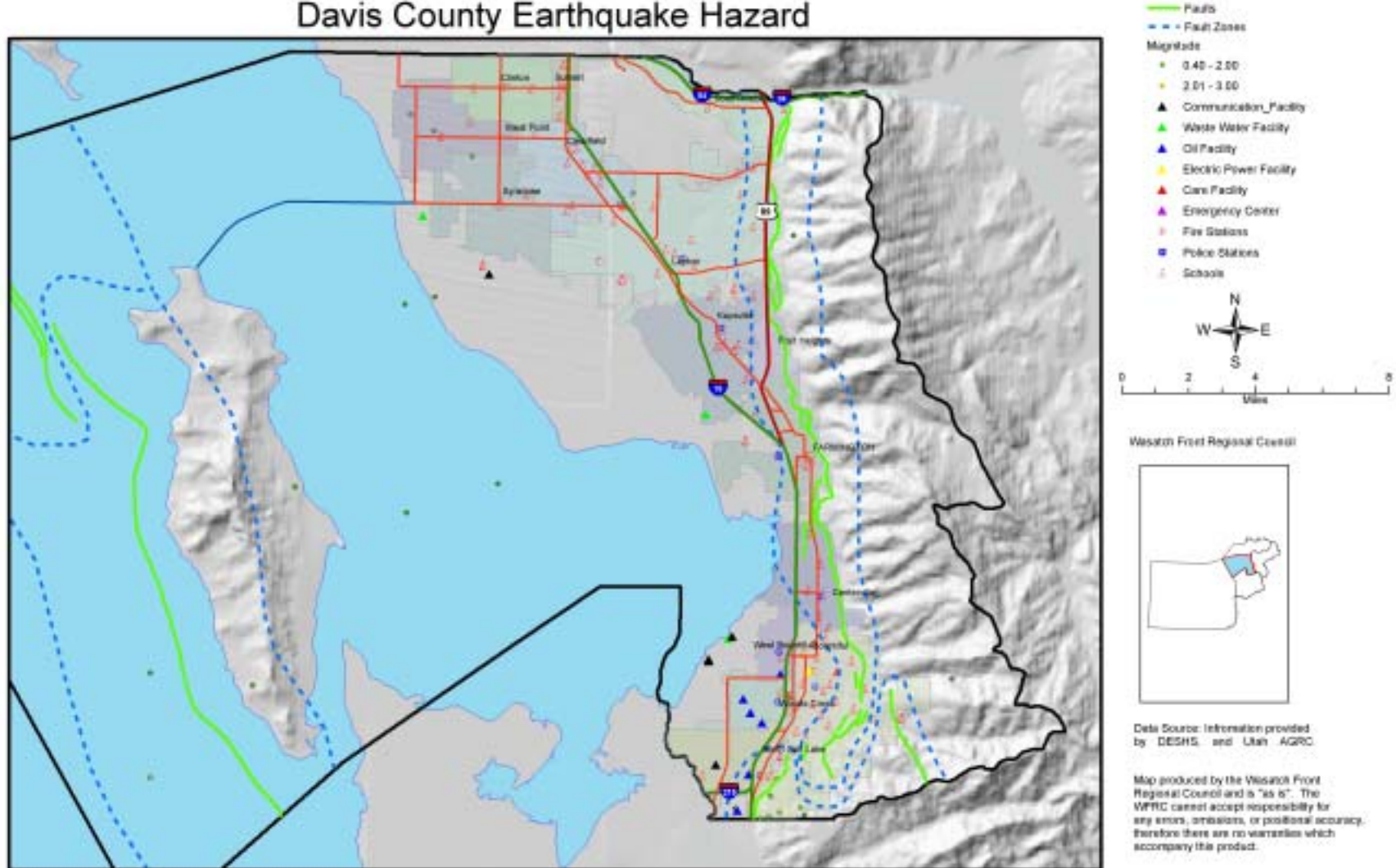
## **H. Mapping**

All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

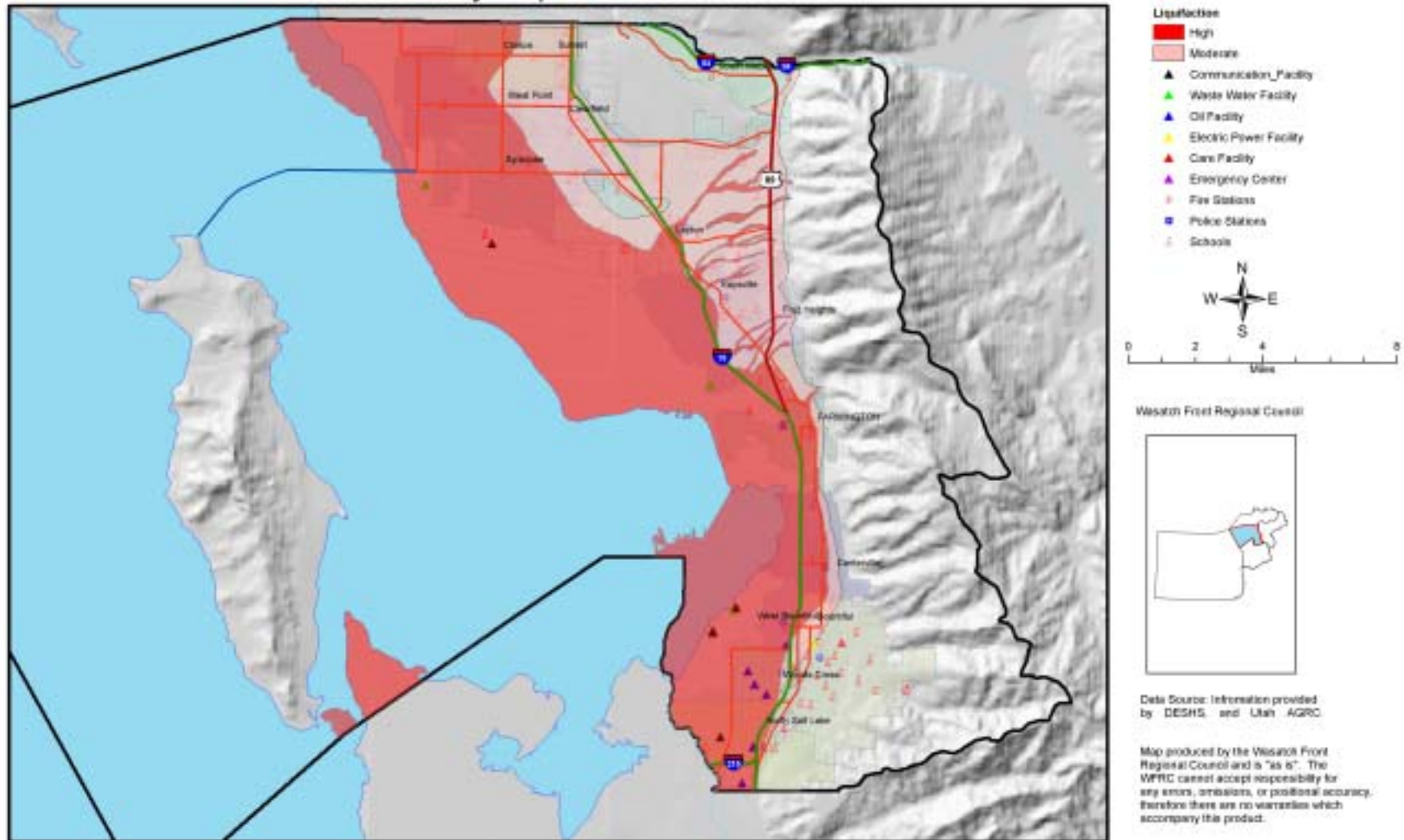
Map 7.1.1 Davis County Earthquake Hazard

Map 7.1.2 Davis County Liquefaction Potential  
Map 7.3.1 Davis County Wildfire Risk  
Map 7.4.1 Davis County Landslide Hazard

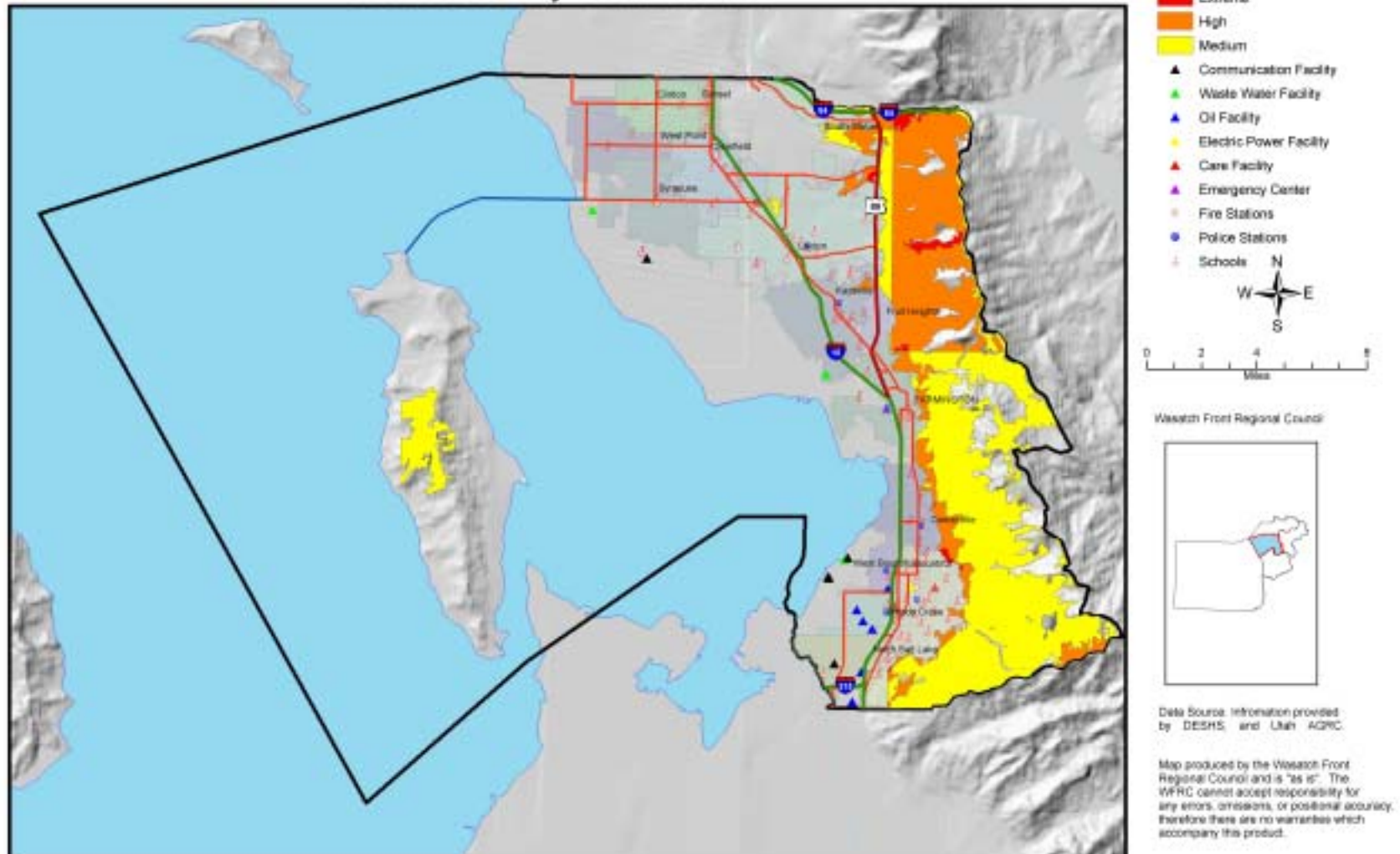
## Davis County Earthquake Hazard



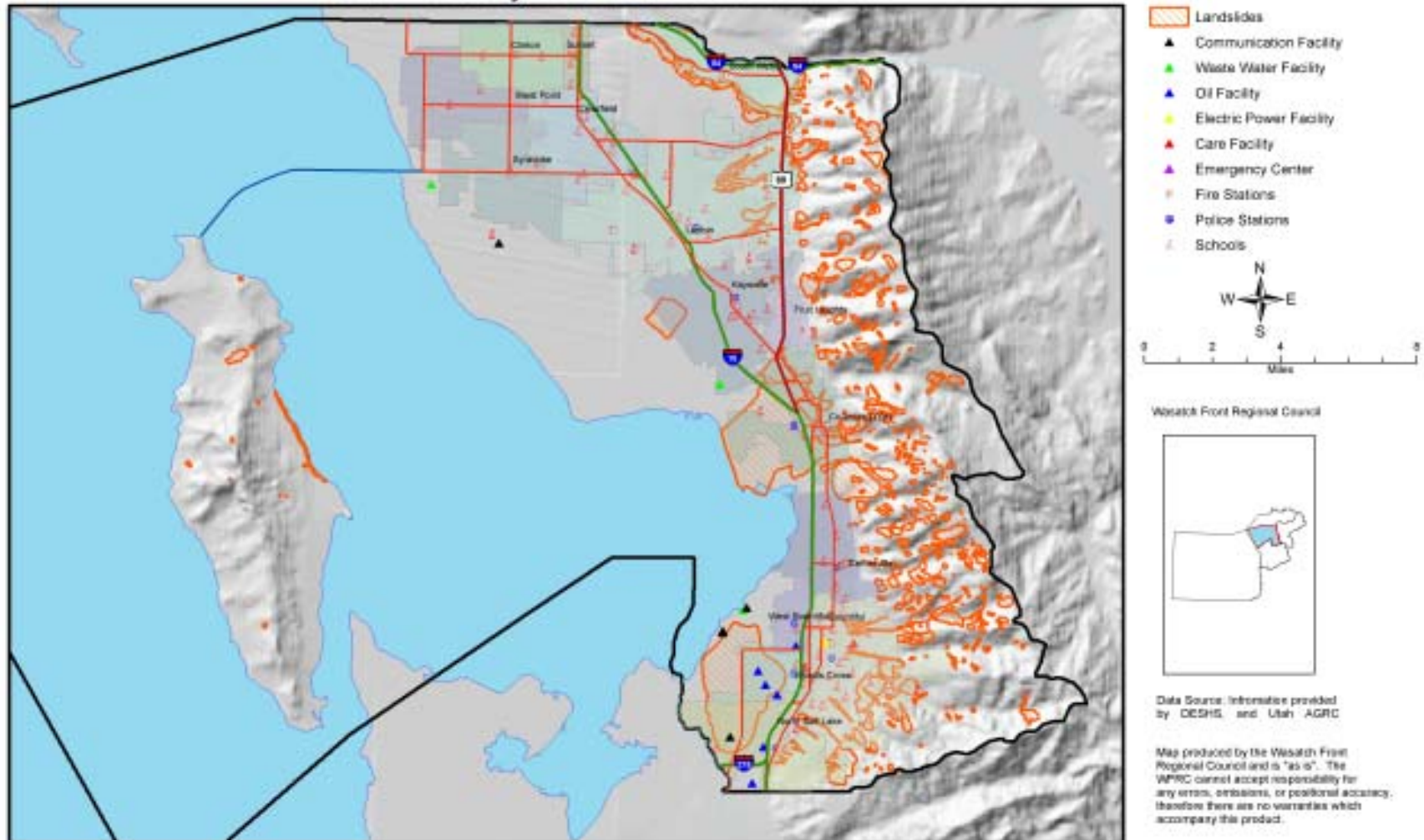
## Davis County Liquefaction Potential



## Davis County Wildfire Risk



## Davis County Landslide Hazard



## Part VIII. Morgan County

Morgan County includes one municipality Morgan City, the county seat, and thirteen unincorporated areas, Como Springs, Croydon, Devils Slide, Enterprise, Littleton, Milton, Mountain Green, Peterson, Porterville, Richville, Stoddard, Taggarts, and Whites Crossing. The main entrance into the county is through Weber Canyon, which opens on both the east and northwest sides of the county. Thirteen tributaries flow into the Weber River from east to west in Weber Canyon. Two dams are located within the county boundaries, East Canyon and Lost Creek. Morgan County is the third smallest county in Utah with 610 square miles. The landscape is made up of high mountains, steppe valleys, one main river valley, the Weber River, and two smaller river valleys, East Canyon and Lost Creek, as well as farming and grazing lands. Morgan City and Mountain Green are the most populated areas. Elevation ranges from 4,895 feet above sea level at Mountain Green to 5,052 feet above sea level at Morgan City to Durst Mountain in the north with 9,284 feet above sea level and Francis Peak to the west with 9,547 above sea level (Morgan County Emergency Operations Plan). The highest point is Thursten Peak at 9,706 feet above sea level.



### A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. An overview of Morgan counties population from Census 2000 data is presented in the table below (Table 8-1).

**Table 8-1 Morgan County Population Growth**

Census Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990- 2000	Percent Change 1990- 2000	AARC 1990- 2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Morgan County	5,528	7,129	1,601	29.0%	2.6	22	19	11	11

<b>Population by County and Multi-County</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000- 2030
Wasatch Front	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Morgan County	4,917	5,528	7,129	7,506	8,329	9,250	9,981	11,312	1.55%
<b>Households by County and Multi-County</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Morgan County	1,355	1,555	2,046	2,258	2,679	3,100	3,437	4,037	2.29%
<b>Average Household Size by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Morgan County	3.63	3.55	3.48	3.32	3.11	2.98	2.90	2.80	-0.72%
<b>Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Morgan County	0.34%	0.32%	0.32%	0.30%	0.30%	0.30%	0.30%	0.30%	-0.21%
<b>Household Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Morgan County	0.30%	0.29%	0.29%	0.28%	0.29%	0.30%	0.30%	0.31%	0.15%
Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.									

## B. Economy

Agriculture, mainly livestock and crop productions, has been the main type of economic activity in Morgan County, along with producing mink pelts. Recently, manufacturing, trade, government, and construction have begun to diversify the economy. Because of Morgan County's close proximity to Salt Lake and Davis County the population is increasing rapidly. The principle employer is Hill Air Force Base (Morgan County Emergency Operations Plan). Some of the largest employers include Morgan County School District, Holnam, Inc., Browning, IGA Grocery, Morgan County, and Wilkinson Construction Company.

The 2001 labor force totaled 3,580 with 3,450 employed and 130 unemployed. In 2001 the per capita income was \$22,708 and the average monthly non-farm wage was \$2,133 and non-farm jobs were \$1,636. In 2001 the top labor force entities included Government, Trade/ Transportation/ Utilities, Construction, and Manufacturing. Total wages in 2001 for the county was \$41.9 million. Total personal income in 2001 was \$165.7 million.

## **C. Transportation and Commuting Patterns**

Interstate 84 (I-84) is the major east-west highway that passes through the middle part of the county. Year 2000 average daily traffic volume on I-84 was 10,881. State Route 167 is a minor artery that runs north-south along the western portion of the county. In year 2000 SR. 167 had an average daily traffic volume of 1,620. State Route 65 runs north-south from Henefer thru the southwestern edge of the county into Salt Lake County and has 1,045 average daily traffic users. Other north-south routes include Route 1972 with average daily traffic volume of 4,130, and State Route 66 with an average daily traffic volume of 1,795. Route 3978 in western Morgan is a highly used short route with the average daily traffic volume of 4,120.

## **D. Land Use**

Morgan County consists of 609 square miles of with the following ownership categories; 90% private, 5% federal, 3% state, .27% underwater. Morgan County has the largest percentage of privately owned land in the state. The Wasatch National Forest extends into the north side of the county. Summit County is on the eastern border and Davis County is on the western border.

Morgan County's population is expected to continue to grow along the Interstate 84 corridor, with the highest concentration of new development being in the southern portion of the county. Development is occurring in areas that once were agricultural or farmland. Morgan County prides itself in its rural setting and the county codes and ordinances for planned development recognize that.

Wildfire risk is most severe in the forested areas of the county. These areas known as URWIN zones are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. A couple ways to mitigation this threat is to encourage communities to become "Fire Wise Communities", continue to require building and zoning codes, and increase the public's awareness.

Flooding is another threat near several rivers that run through the county. Special attention should be given to new and existing development in these areas where the potential for flooding is high.

These are just some examples of the mitigation actions that can be put into place when new development occurs. Specific mitigation actions for Morgan County can be found in Section G

## **E. Risk Assessment**

The risk assessment process revealed the following for the identified hazards of earthquake, flood, dam failure, wildland fire, severe weather, and drought. Severe weather and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and are included at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 8 critical facilities in Morgan County, none of which are located within the hazard boundaries of the mapped hazards. Refer to Appendix D for the complete list of critical facilities for the county.

# 1. Earthquake

## Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Western Portion along the Intermountain Seismic Belt will probably be the most affected. Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

## Description of Location and Extent

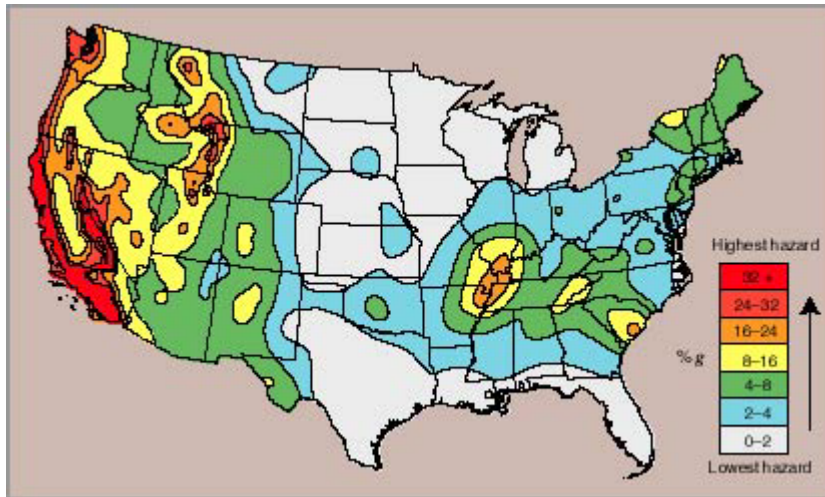
In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years. Morgan County is situated between two segments of the Wasatch Fault, the Weber Segment and the Salt Lake Segment.

The combined average repeat time for large earthquakes on any of the five central segments (Brigham city, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years. The average repeat time on any single segment ranges from about 1200-2600 years. Earthquakes on any of the five central segments occurred from 620 to 2120 years ago. On the Salt Lake City segment the probability has been estimated as high as 57 percent in 100 years.

The Weber Segment runs from North Salt Lake along the eastern edge of the valley to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years, making it one of the most active fault segments. The Weber County Segment of the Wasatch Fault could therefore create a magnitude 7.0 or above earthquake which would be very damaging to the entire county. The Salt Lake Segment underlies the Salt Lake valley.

Smaller fault zones also pose a threat to Morgan City, which include East Canyon, Devils Slide, and Lost Creek. The seismic hazard expressed by the United States Geological Survey has identified Utah as having a moderate to high hazard rating (Figure 8-3).

**Figure 8-3 Probabilistic Seismic Hazard Map**



Using latitude and longitude, earthquake ground motion can be looked up on the USGS website. Table 8-2 identifies ground motion hazard values and Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These are expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years.

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but is only approximate due to building design and demand. The probability of exceedence is based on some average probability per year, all probabilities are added, a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain time in years. The values listed are for the nearest grid point in decimal degrees 40.70000 Lat and -69.3999 Long

For a more detailed explanation of values used and metadata refer to the [USGS Earthquake Hazards Program](#) website listed in the works cited appendix. The 10% g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage.

**Table 8-2 Earthquake Probabilistic Hazard- Ground Motion Values**

	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
<b>Morgan City 41:02:33 Lat 111:40:58 Long</b>			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307

#### **Vulnerability Analysis**

The vulnerability analysis for Morgan County identifies the number of people and property that could be affected by an Earthquake including property type and numbers, building values, and infrastructure. These values are presented in Table 8-3, and 8-4.

**Table 8-3 Inventory of Properties Located within Earthquake Fault Zones**

City Name	City Area	Acres in Fault Zone	Population within Fault Zone	Number of property structures within Fault Zones	
				Residential /Replacement Value	Commercial /Annual Sales
Morgan City	1,935	499	359	122/ \$22,909,160	8/ \$1,200,000
Unincorporated Morgan County	387,825	13,486	453	100/ \$187,780,000	4/ \$1,000,000

**Table 8-4 Infrastructure affected by earthquake**

Item	Length (Miles)	Replacement Cost
Local Roads	7.04	\$14,084,000
State Highways	4.79	\$11,551,735
US Highways	0.00	\$0
US Interstates	2.04	\$7,327,440
Power Lines	9.91	\$478,455
Gas Lines	1.73	\$417,605

**HAZUS MH Vulnerability Assessment**

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 8-5 identifies the probable casualties during an earthquake.

**Table 8-5 Casualties**

Casualties	Nighttime –Minor	38
	Nighttime –Major	1
	Nighttime -Fatalities	2
	Daytime –Minor	40
	Daytime –Major	1
	Daytime- Fatalities	3
	Commute –Minor	44
	Commute –Major	1
	Commute-Fatalities	3

**Building Damage by Count**

HAZUS MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 8-6 lists the number of buildings by occupancy, which are estimated to have moderate to complete levels of damage. Table 8-7 identifies the critical facilities that would be damaged.

**Table 8-6 Building Damage by Count with Moderate to Complete Damage**

Category	Number of Structures
Residential	47
Commercial	8
Industrial	4
Totals	828*

\*Includes all building categories with moderate to complete damage

**Table 8-7 Critical facilities**

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	3	0	0	0
Emergency Operations Centers	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	2	0	0	0

**Debris Removal**

Table 8-8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

**Table 8-8 Debris Generated (thousands of tons)/Loads to Remove Debris**

Debris Generated	33
Loads (25 tons per load)	1,320

**Fire following**

The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 8-9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

**Table 8-9 Fire Following Event, Population Exposed, and Building Stock Exposed**

Ignitions	1
People Displaced	0
Value Exposed (mill. \$)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

Please refer to Map 8.1.1 titled Morgan County Earthquake Hazard located in Section H that displays earthquake epicenter and fault zone locations atop a shaded relief base map to help distinguish topography.

## 2. Flood

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Weber River and its tributaries.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

### Description of Location and Extent

Flooding in Morgan County has been mainly associated with heavy rainfall from cloudburst storms; however rapid snowpack melt can cause flooding and flash flooding in the county as well. Historical events suggest that these events would pose the most threat to the county.

Precipitation in Morgan County is mainly attributed to the Wasatch Front Mountain Range. Unusually heavy rain and snowpack can result in flooding, mud, debris flows, and avalanches on steep slopes near the foothills.

The Weber River and its tributaries (East Canyon Creek, Lost Creek, Hardscrabble, Deep Creek, and Peterson Creek) pose the most significant flood threat to the county (Figure 8-4). Lost Creek has experienced flooding in the past due mainly to bridges obstructed with debris. Gordon Creek has also experienced flooding in the past. The problem at Gordon Creek is due to the perched channel that causes surface flooding. Sewer and water lines cross the Weber River and the spring flooding of 1983 caused the sewer line to break. The sewer line is now encased with concrete so should not pose a problem in the future. If Morgan County experienced another flood event similar to the one of 1952 and 1983-1984 the Como Bridge could potentially fail due to age. If a 50 or 100 year flood event were to occur, Deep Creek would experience overbank flooding. Agricultural flooding is also of concern because of the amount of farmlands.

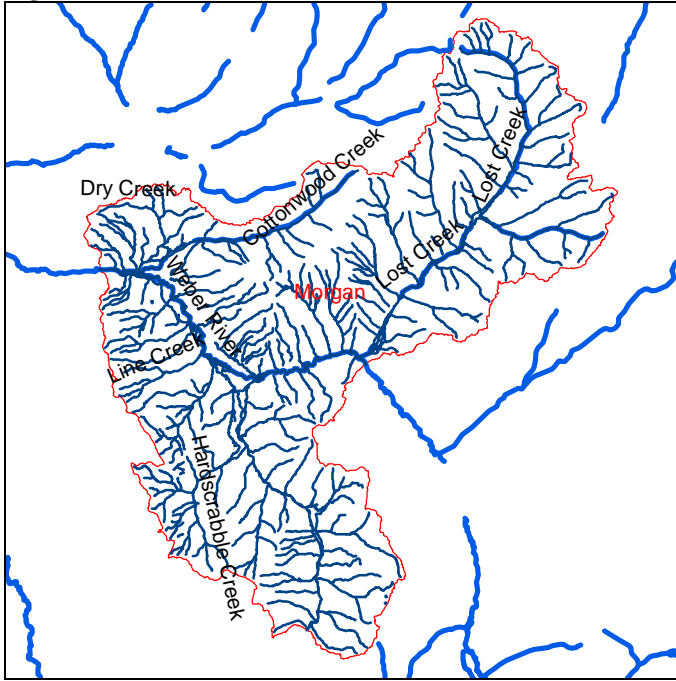
Island Road along East Canyon Creek, Richfield, Highlands, and Mountain Green between I-84 and the old highway could experience residential and commercial flooding. Morgan High, Junior, Middle and Morgan County Elementary Schools are all located in the floodplain, as is the entire city of Morgan.

### Vulnerability Assessment

At this time, a vulnerability assessment was unable to be performed due to the lack of digitized floodplain maps and datasets used to conduct the assessments for the other natural hazards that affect the county. The lack of digital data combined with the large population inhibited flood vulnerability losses. While there is a flood risk in Morgan County the planning team felt that the time required to complete a flood vulnerability assessment could be better utilized. However, current mapping projects are being completed by the state that will result in better data and therefore a greater understanding of risk. The county would like to continue to work with the state to understand their threats; therefore general mitigation goals have been included and can be found in Appendix C.

As a result of the lack of digitized data and flood maps the flood portion of this plan is deficient. A way to help with this deficiency the WFRM contracted with the Utah Army Corps of Engineers to complete a flood hazard identification study for the unmapped county or those areas mapped as a zone D, this study can be found in Appendix G.

**Figure 8-4**



### 3. Dam Failure

#### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Dam locations are mainly in the southeastern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

#### Description of Location and Extent

Twenty-one dams are located in Morgan County. Four of which are listed as a high hazard threat, meaning if they fail they have a high probability of causing loss of life and extensive economic loss. Three dams are listed as a moderate hazard threat meaning if they fail they have a low probability of causing loss of life but would cause appreciable property damage and mitigation efforts should be developed and pursued. Twelve dams have a low hazard threat, if they were to fail there would be a minimal threat to life and economic losses would be minor and the damage would be limited to the owner of the dam, however they should still be monitored.

It should be noted that Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State Engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

#### Vulnerability Assessment

A vulnerability assessment for dam failure was difficult to analyze due to the quality and age of the dam inundation maps from the Dam Safety Section of Utah Water Rights. Some of the critical facilities were identified that were within the inundation areas for each of the high hazard dams and these facilities are listed in Table 8-10. However, due to the lack of digitized dam inundation maps potential loss estimates were unable to be identified. Refer to map 8.4.1 Morgan County Dam Hazard for dam locations and geographic extent.

**Table 8-10 High Hazard Dam Inventory**

East Canyon	
Owner	Department of Interior, Bureau of Reclamation
River	East Canyon Creek
Near City/ Distance	Morgan City/ 10.1
Year Completed	1966
Dam Length	436 ft
Dam Height	185 ft
Max Discharge	6200 cfs
Max Storage	58,350

Normal Storage	51,200
Surface Area	747
Drainage Area	145
Spill Type/ Width/ Volume	U/ 50/ 35,716
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	Portersville is downstream town, 7miles away. No digital copy of the EAP.

<b>Wilkinson</b>	
Owner	Max Wilkinson
River	Bohman Wash
Near City/ Distance	
Year Completed	1957
Dam Length	524
Dam Height	53
Max Discharge	1,384
Max Storage	353
Normal Storage	285
Surface Area	18
Drainage Area	3
Spill Type/ Width/ Volume	B/ 0/ 0
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	Homes below dam. No identifiable critical facility in inundation zone

<b>Northwest</b>	
Owner	Northwest Irrigation Co
River	Cottonwood Creek
Near City/ Distance	Mountain Green/ 2
Year Completed	1940
Dam Length	800
Dam Height	36
Max Discharge	30
Max Storage	603
Normal Storage	523
Surface Area	25
Drainage Area	0
Spill Type/ Width/ Volume	B/ 0/ 0
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

<b>Lost Creek</b>	
Owner	Department of Interior, Bureau of Reclamation
River	Lost Creek
Near City/ Distance	Devils Slide/ 12
Year Completed	1966
Dam Length	1,110 ft
Dam Height	173 ft
Max Discharge	2,455 cfs
Max Storage	26,760
Normal Storage	22,510
Surface Area	415
Drainage Area	123
Spill Type/ Width/ Volume	U/ 18/ 1,832,000
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	No digital copy of the EAP.

## 4. Wildland Fire

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

### Description of Location and Extent

Wildfire threat within the county is most considerable in the private rangeland and open farmland areas. The county does not have a serious URWIN threat because of lower resident numbers living in the foothills. However, this could change due to increased residential development.

Wildfire maps were created using GIS and can be viewed in Section H Map 8.4.1 Morgan County Wildfire Risk. The map layers were provided by DESHS and show three categories of wildfire risk:

- Extreme
- High
- Medium

These ratings cover all of Morgan County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed, and direction are not considered in this risk assessment.

### Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population within each of the areas is also included. Please refer to Table 8-11, 8-12, and 8-13 for population, structures, and infrastructure in wildfire areas.

There are no critical facilities located in extreme, high or moderate wildfire risk areas in Morgan County.

**Table 8-11 Morgan City Wildfire Hazard**

Morgan City				
Total Area of Municipality	1935 Acres	Population in Hazard Area	Number of Structures in Hazard Area	
			Residential/Replacement Cost	Commercial/Annual Sales
Acres Extreme	112	32	12 / \$7,886,760	1 / \$400,000
Acres High	156	100	30 / 563,340	No Known Risk
Acres Moderate	1	0	No Known Risk	No Known Risk

**Table 8-12 Unincorporated Morgan County Wildfire Hazard**

<b>Unincorporated Morgan County (Total area 387,825 acres)</b>				
	<b>Acres</b>	<b>Population in Hazard Area</b>	<b>Number of Structures in Hazard Area</b>	
			<b>Residential/ Replacement Cost</b>	<b>Commercial/ Annual Sales</b>
Acres Extreme	2,188	285	67 / \$12,581,260	No Known Risk
Acres High	13,635	246	77 / 14,459,060	8 / \$3,600,000
Acres Moderate	23,001	1,359	459 / \$86,191,020	16 / \$14,300,000

**Table 8-13 Infrastructure affected by Wildfire**

<b>Item</b>	<b>Length (Miles)</b>	<b>Replacement Cost</b>
Local Roads	4.66	\$9,320,000
State Highways	4.74	\$11,440,955
US Highways	0.00	\$0
US Interstates	10.36	\$37,312,560
Power Lines	36.65	\$1,769,462
Gas Lines	0.00	\$0

## F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Hazard history events are listed in Table 8-14, and include as much relevant information as was available including date, location, areas impacted, and damage costs.

**Table 8-14 Hazard History**

<b>Hazard</b>	<b>Date</b>	<b>Location</b>	<b>Critical Facility/ Area Impacted</b>	<b>Comments</b>
Tornado	June 5, 1953			F1. No injuries or deaths.
Flash Flood	July 18, 1954		Richville	Damage to farm equipment and property.
Earthquake	June 25, 1955	Morgan		Richter magnitude 3.7
Flood	August 16, 1958	Weber Canyon	Yence Hollow above Round Valley	10 inches in 1 hour. Damage to property in the northern portion of the town and to US 30-5.
Earthquake	May 11, 1965		12 miles NE of Morgan	Richter 4.1
Earthquake	September 2, 1967		South of Huntsville	Richter 3.0
Earthquake	April 16, 1972		Near Devil's Slide	Richter 3.5
Lightning	July 24, 1981	Morgan City	Near golf course.	1 death.
Wildfire	July 26, 1988		"Blue Fork Range" fire	Caused by lightning. 300-999 Acres.
Wildfire	July 4, 1992		"Redrock Canyon" fire	Caused by campfire. 1000-4999 Acres.
Wildfire	July 23, 1992		"Pioneer" fire	Caused by campfire. 1000-4999 Acres.
Wildfire	August 1, 1992		"Deseret/ Spring Canyon" fire	Caused by lightning. 1000-4999 Acres.
Wildfire	July 28, 1994		"Trappers Loop" fire	Caused by lightning. 300-999 Acres.
Wildfire	September 6, 1994		"Lost Creek Dam Camp" fire	Caused by lighting. 300-999 Acres.
Wildfire	August 28, 1996		"Mormon Trail" fire	Caused by equipment. 300-999 Acres.
Wildfire	August 30, 1997		"Cottonwood Fire"	Caused by Incendiary. 300-999 Acres.

## G. Mitigation Goals, Objectives, and Actions

**Morgan County's Emergency Management Department**  
**Terry Turner**  
Emergency Management Director

### Attend PDM Planning Meetings with County Planner(s).

**Date:** 11/14/2003  
**Time:** 1:00 pm  
**Place:** Morgan Fire Station

**Purpose of Meeting:**

To establish our Mitigation objectives and to begin our worksheets rough draft.

**List of Attendees:**

Terry Turner  
Kimberli Turner

**Summary of Meeting:**

Established the following objectives (Flood, Earthquake, Severe Storms, Drought, Dam Failure)

**Outcome(s) of Meeting:**

Finalize worksheets rough draft to have ready for the Regional meeting on November 20<sup>th</sup>.

### Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s).

**Date:** 11/20/2003  
**Time:** 2:30 pm  
**Place:** Morgan Fire Station

**Purpose of Meeting:**

To Gather More Information On Our Mitigation Objectives.

**List of Attendees:**

Terry Turner  
Kimberli Turner  
LaNiece Dustman  
Jim Boes

**Summary of Meeting:**

Went over our rough copy of the Mitigation plan. Discussed more detail on identifying the problem.

**Outcome(s) of Meeting:**

Have a final meeting with county engineer. Make changes that were suggested. Send in finished copies.

### Attend PDM Planning Meetings with County Planner(s).

**Date:** 12/4/2003  
**Time:** 3:00 pm

**Place:** County's Engineers' Office

**Purpose of Meeting:**

To have county engineer have a final check on the Pre-Mitigation Plan

**List of Attendees:**

Terry Turner

Kent Wilkerson

**Summary of Meeting:**

Went over final copy of worksheet objectives.

**Outcome(s) of Meeting:**

He agreed with the workbook and the final objectives.

\*The term "countywide" in this document refers to mitigation strategies benefiting the City of Morgan and the communities; Stoddard, Peterson, Croydon, Mt. Green, Enterprise, Milton, Littleton, Richeville, and Porterville.

**Hazard: Flood**

**Problem Identification:**

Morgan County has two major rivers (East Canyon, Weber) that threaten communities during spring runoff.

**Goal #1:**

Lessen Impact from flooding.

**Objective #1: Priority HIGH**

To Reduce Flood Threat To Morgan County

**Action #1:**

Maintenance of channels and bridge openings

Time Frame: Immediate

Funding: Routine maintenance

Estimated Cost: Minimal

Staff: County Road Dept.

Background: Keep channels free of debris and clear out gravel bars, watch for constriction during high flow.

**Action #2:**

Work with Weber Basin to increase flood storage area

Time frame: Two-Three years

Funding: Undetermined/Potentially Grants

Estimated Cost: Undetermined dependant upon decided outcome

Staff: Emergency Management /Contract

Background: Work with Weber Basin to increase the percentage of area that is allotted for flood storage.

**Action #3:**

Advise Residents and Develop Outreach Materials on the Availability of Flood Insurance

Time Frame: Immediate

Funding: County

Estimated Cost: Minimal

Staff: Emergency Management, County and Morgan City Floodplain Administrator, State Floodplain Manager

Background: Inform residents to the potential risk of flooding and advise them that flood insurance is available.

**Goal #2:**

Reduce threat of unstable canals throughout the county.

**Objective #1: Priority MEDIUM**

Identify countywide canal systems

**Action #1:**

Map and assess for structural integrity canal systems in the County

Time Frame: 3-5 years

Funding: Federal grants

Estimated Cost: Unknown

Staff: County and City Public Works, Canal Companies, County Engineering

Background: Private and Public canals are used for transportation and dispersion of water as well as flood control. They also represent a hazard to structures and infrastructures.

**Hazard: Earthquake**

**Problem Identification:**

Critical facilities (public safety, commercial buildings, schools) need to be made less vulnerable from the impact of earthquakes to allow a more timely response, and to decrease the impact to lives.

**Goal #1:**

Reduce Loss of Life and Damage to Property

**Objective #1: Priority HIGH**

Decrease the Negative Effect of Earthquakes Within the County

**Action #1:**

Begin an Earthquake awareness campaign to include awareness of availability of earthquake insurance

Time Frame: One – Two years

Funding: County

Estimated Cost: Minimal

Staff: Emergency Management/Contract

Background: Work in conjunction with National Earthquake Awareness Week to put together a county awareness week.

**Action #2:**

Facilitate a Pre-Earthquake damage assessment. To evaluate retro fix critical facilities

Time Frame: Immediate – One year

Funding: County/ City

Estimated Cost: Moderate/Extensive

Staff: City – County Engineer's/Contract

Background: Inspect commercial buildings to see which ones are up to earthquake code.

**Action #3:**

Work with the county's businesses to ensure proper earthquake preparedness training

Time Frame: One – Five years

Funding: County / Grant

Estimated Cost: Minimal

Staff: Emergency Management / Contract

Background: Devise training schedule to ensure that all county businesses are properly trained.

### **Hazard: Dam Failure**

#### **Problem Identification:**

Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.

#### **Goal #1:**

Reduce loss of life and limit damage to property.

#### **Objective #1: Priority MEDIUM**

To Increase Community Awareness of the (Federal, State and Private) Dam's That Will Impact The County

#### **Action #1:**

Educate community of evacuation routes

Time Frame: One – Two years

Funding: County

Estimated Cost: Minimal

Staff: Emergency Management

Background: Work with public media to inform the community of proper evacuation routes.

#### **Action #2:**

Improve Emergency Notification Systems/Public Awareness Dam Information

Time Frame: Over the next five years

Funding: Bureau of Reclamation

Estimated Cost: High/Extensive

Staff: Emergency Management/Bureau of Reclamation

Background: To work with the Bureau of Reclamation to install an early warning electronic notification system.

#### **Action #3:**

Improve Inundation Maps

Time Frame: Immediate

Funding: Bureau of Reclamation

Estimated Cost: Moderate

Staff: Emergency Management/Bureau of Reclamation

Background: Improve current maps and have them digitally formatted

### **Hazard: Drought**

#### **Problem Identification:**

The residents' of Morgan County are unaware of the water conservation options that are available to them.

#### **Goal #1:**

Decrease the Impact of Drought On The Community.

#### **Objective #1: Priority LOW**

Develop and promote water conservation measures.

#### **Action #1:**

Promote water conservation utilizing Drought Contingency Plan  
Timeframe: Immediate  
Funding: County/Grant  
Estimated Cost: Minimal  
Staff: Emergency Management/Contract/Soil Conservation/Extension  
Background: Join with the State's "Slow – The – Flow" campaign

**Action #2:**

Promote the use of the secondary water system  
Timeframe: Immediate  
Funding: Secondary Water Board  
Estimated Cost: Minimal  
Staff: Secondary Water Board / Emergency Management / City  
Background: Work with the Secondary Water board and the city to improve the use of the new secondary water system.

**Hazard: Severe Weather**

**Problem Identification:**

Snowstorms, Hail, Thunderstorm/Lighting, Heavy Rain, Wind and Avalanche impact Morgan County. This is intensified by Morgan County's remote location.

**Goal #1:**

Assist residents protect themselves from the affects of severe weather.

**Objective#1: Priority MEDIUM**

Lessen The Impact of Severe Storms to Resident's and Businesses Within Morgan County

**Action #1:**

Increase residents' awareness of the need for food storage for use during severe storms.  
Time Frame: One – Three years  
Funding: County/Grants  
Estimated Cost: Minimal  
Staff: Emergency Management / Extension  
Background: Use public media to increase the resident's awareness of the effect of severe storms and road closures could have on them and their families.

**Action #2:**

Increase residents' awareness of where emergency shelters are located  
Time Frame: One – Three years  
Funding: County/Grant  
Estimated Cost: Minimal  
Staff: Emergency Management/Contract  
Background: Use public media to increase awareness of locations of shelters that are available.

**Action #3:**

Have all cities in the county participate in the Storm Ready program.  
Time Frame: 1 Year  
Funding: County t  
Estimated Cost: Minimal  
Staff: County Emergency Management, NWS, and State DESHS  
Background: National Weather Service Storm Ready Program is a proven proactive severe weather mitigation activity.

**Action #4:**

Encourage avalanche preparedness for county backcountry users.

Time Frame: 1 Year

Funding: Minimal

Estimated Cost: Minimal

Staff: County Emergency Manager, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.

Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual is more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Morgan County. Most avalanche victims die in avalanches started by themselves or someone in their party. Therefore, education can limit the number of avalanche related searches each year.

**Hazard: Wildfire****Problem Identification:**

Continuing non-compliance with existing building codes and fire codes.

**Goal #1:**

Building and Fire Code Compliance

**Objective #1: Priority HIGH**

Increase compliance with existing building and fire codes.

**Action #1:**

Develop and enforce current local, state and national codes.

Time Frame: Ongoing

Funding: Local, state and federal grants

Estimated Cost: Unknown

Staff: Local, state and federal agencies

Background: Implement and enforce rules, regulations and codes

**Goal #2:**

Wildfire Community Education

**Objective #1: Priority HIGH**

Reduce overall risk from wild fire through education programs. Especially in the Mt. Green, Trappers Loop, area east of Porterville, and East Canyon.

**Action #1:**

Public awareness through "Fire Wise" programs.

Time Frame: 2-3 years

Funding: Unknown

Estimated Cost: Unknown

Staff: Fire Departments, Utah Living With Fire, US Forest Service, and UFFSL

Background: Wildfire education will be part of a holistic natural hazard education program pushed countywide. The program will include training on wildfires, earthquakes, flooding, landslides, and severe weather. Fire Wise training will include Utah specific wildfire safety material developed by the Utah Living With Fire Committee. Urban Wildland Interface areas will be identified and targeted. County fire department/district in the past have pushed wildland fire prevention and protection

techniques with success. Other fire department/districts have used door hangers discussing defensible space.

**Action #2:**

Provide wildfire training to city and county planning and zoning officials and staff.

Time frame: Immediate

Funding: Unknown

Estimated Cost: Unknown

Staff: UFFSL, DES, National Forest Service.

Background: County Planners need to understand issues related to wildland fire fighting, such as water and access, in order of properly plan for development of lands in the urban/wildland interface.

**Hazard: Landslide**

**Problem Identification:**

Morgan County has a significant threat of landslides. The community of Mt. Green and Trappers Loop Road (Highway 167) as well as critical pipeline routes can be impacted by landslides.

**Goal #1:**

Avoid risk or exposure to landslides through informed planning and zoning decisions.

**Objective #1: Priority LOW**

Educating planning commissions

**Action #1:**

Provide City and County Planning Commissions with information concerning landslides.

Time Frame: One – Two Year

Funding: None

Estimated Cost: None

Staff: County Engineer/UGS

Background: Decision-makers (Elected Officials) are critical in overall planning process and in the support of long-term natural hazard planning efforts.

**Objective #2: Priority MEDIUM**

Monitor historical landslide areas.

**Action #1:**

Evaluate current landslide maps to verify accuracy.

Time Frame: Unknown

Funding: Federal Grants

Estimated Cost: Unknown

Staff: Emergency Services, County Engineer, UGS, and USGS

Background: Currently available mapping on active landslides within Morgan County may not reflect accurately the risk on the ground.

## **H. Mapping**

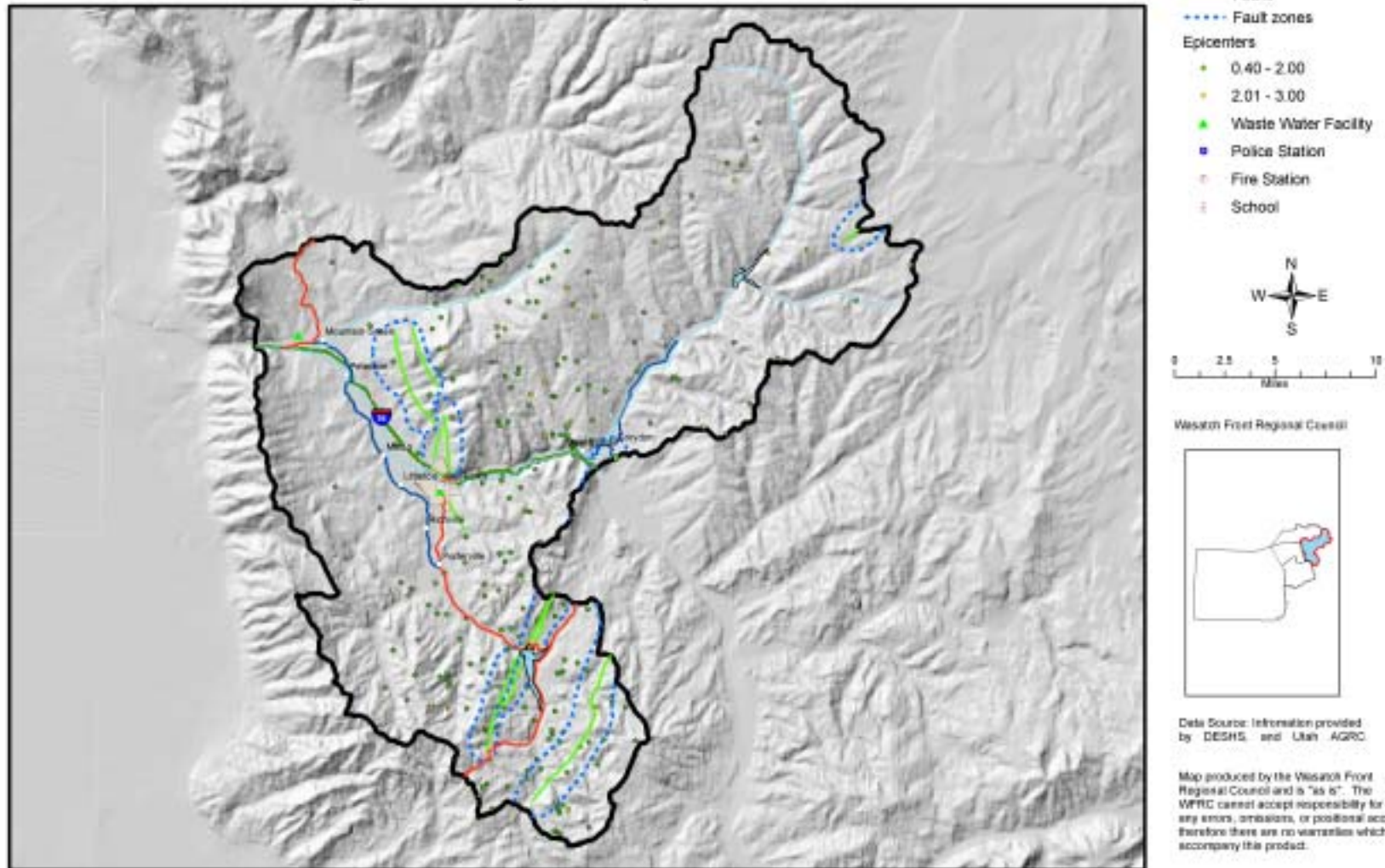
All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRM and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 8.1.1 Earthquake Hazard

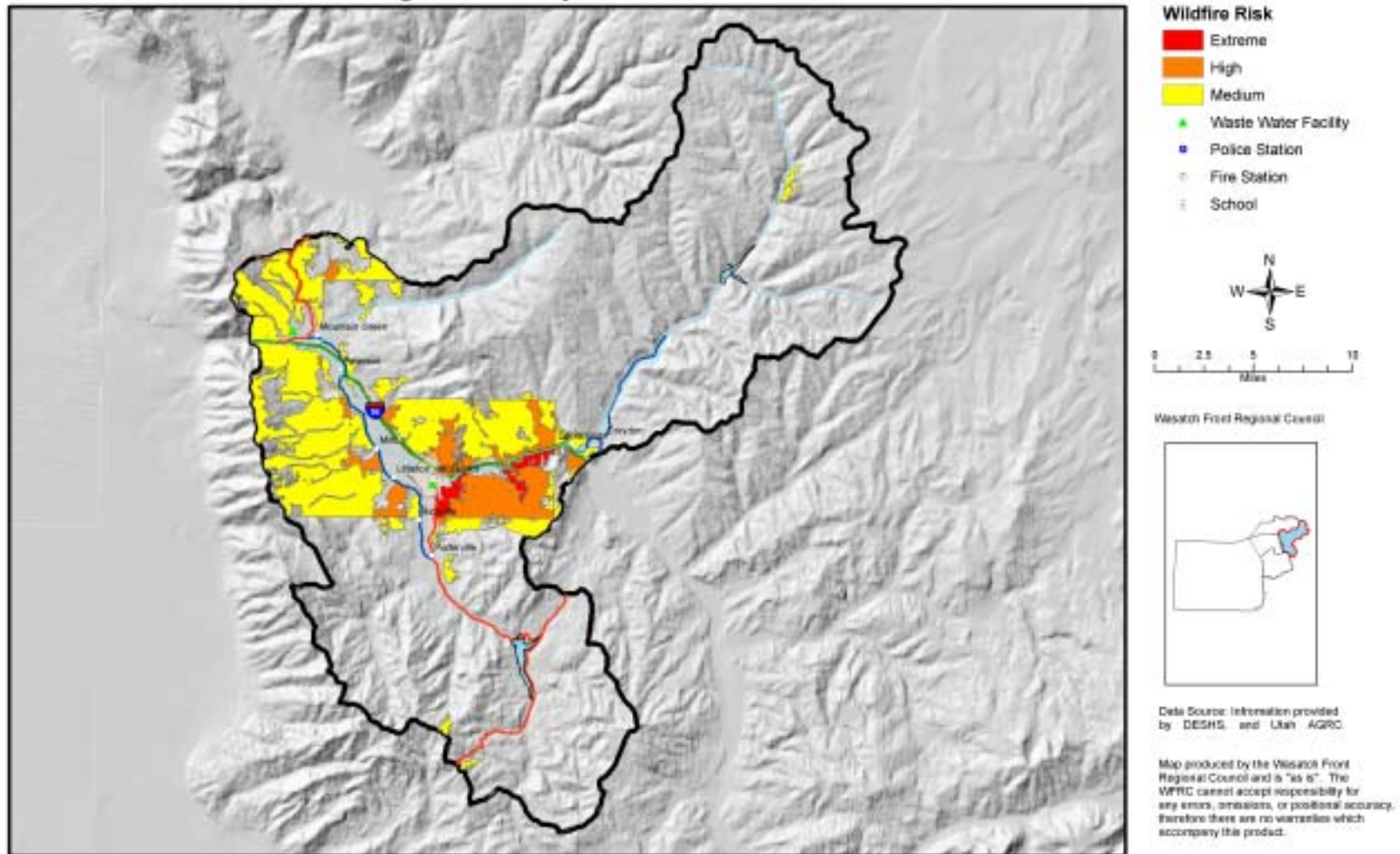
Map 8.4.1 Wildfire Hazard

Map 8.3.1 Dam Hazard

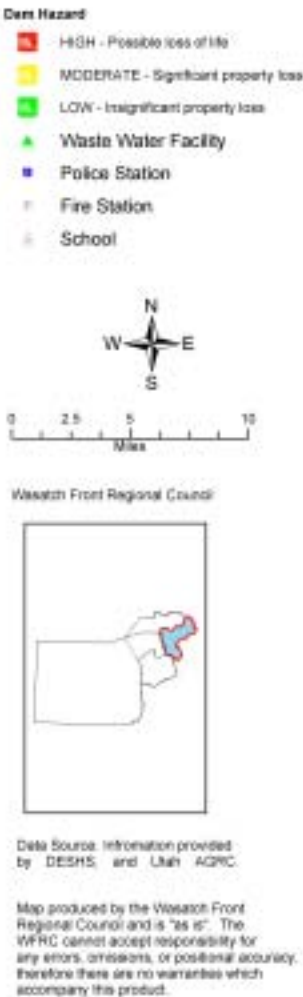
## Morgan County Earthquake Hazard



## Morgan County Wildfire Risk

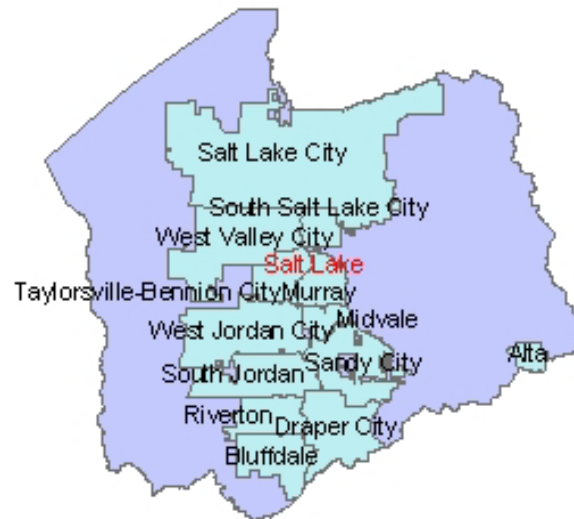


# Morgan County Dam Hazard



## Part IX. Salt Lake County

Within Salt Lake County are fifteen municipalities: Town of Alta, Bluffdale City, city of Draper, Herriman, Holladay-Cottonwood City, Midvale City, Murray City, Riverton City, Salt Lake City, Sandy City, city of South Jordan, city of South Salt Lake, city of Taylorsville, West Jordan City, and West Valley City.



### A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. These figures include population projections into the year 2030 according to Census 2000 data (Table 9-1).

**Table 9-1 Population**

Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990- 2000	Percent Change 1990- 2000	AARC 1990- 2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AAR C
Salt Lake County	725,956	898,387	172,431	23.8%	2.2	1	1	16	15
Population by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Salt Lake County	619,066	725,956	898,387	967,390	1,077,556	1,195,554	1,283,784	1,431,843	1.57%

<b>Households by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AAR C 2000- 2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Salt Lake County	201,742	240,367	295,141	326,570	371,312	418,735	458,906	528,491	1.96%
<b>Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000- 2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Salt Lake County	42.37%	42.14%	40.23%	39.25%	38.65%	38.24%	38.08%	37.96%	-0.19%
<b>Household Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Salt Lake County	44.97%	44.74%	42.09%	41.19%	40.61%	40.28%	40.17%	39.95%	-0.17%
<b>Average Household Size by County and Multi-County</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Salt Lake County	3.03	2.98	3.00	2.92	2.86	2.81	2.75	2.67	-0.39%
Source: Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget. 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes. Note AARC is average annual rate of change.									

## B. Economy

Salt Lake County is the backbone of Utah's economy making up 50% of the job market. The service's industry is the largest employment division within the county supplying 26% of the area's wages. Trade is the second major component and manufacturing is also an important income industry, almost matching government. The largest number of government-related employees is located in Salt Lake County (Table 9-2). Salt Lake is also a regional finance center, a health care center, and a high tech center. Refer to the following information provided by the Utah Department of Workforce Services (Figure 9-1, 9-2).

**Table 9-2 Salt Lake County Employment 2000**

<b>Civilian Labor Force</b>	<b>482,461</b>
Employed	468,130
Unemployed	14,332
Percent of Labor Force	3.0%
<b>Total non-farm Jobs</b>	<b>545,044</b>
Goods Production	94,676
Mining	2,797
Construction	34
Manufacturing	57
Service Production	450,368
Trans. Comm., Utilities	42,709
Trade	127,285
Wholesale	35
Retail	92
Fin., Ins., & Real Estate	40,970
Services	161
Government	77
Federal	8,611
State	33,950
Local	35,342

**Figure 9-1 Demographics**

<b>Income and Wages</b>					
	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002p</b>
Total Personal Income (\$Millions)	22,091.0	23,195.2	24,851.7	25,665.7	N/A
Per Capita Income	25,051	26,029	27,587	28,188	N/A
Avg Family Income from IRS Returns	47,908	51,706	54,244	52,798	N/A
Average Monthly Nonfarm Wage	2,433	2,533	2,662	2,740	2,788
Source: U.S. Bureau of Economic Analysis, Utah State Tax Commission, Utah Department of Workforce Services.					
<b>Sales and Building</b>					
	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>
Gross Taxable Sales (\$000s)	14,480,792	15,032,355	15,941,513	15,849,186	15,706,066
Permit Authorized Construction (\$000)	1,465,718	1,403,778	1,421,173	1,389,799	1,141,988
New Residential Building Permits	6,416	5,286	4,666	5,429	5,406
Residential Build Permits Value (\$000)	653,007	579,376	544,608	628,385	653,464
Source: Utah Tax Commission and University of Utah Bureau of Economic and Business Research.					

Labor Force					
	1998	1999	2000r	2001r	2002p
<b>Labor Force</b>	466,897	474,708	503,402	508,259	514,614
<b>Employed</b>	451,165	458,549	488,550	486,456	482,260
<b>Unemployed</b>	15,732	16,159	14,852	21,803	32,354
<b>Rate</b>	3.4%	3.4%	3.0%	4.3%	6.3%
<b>Nonfarm Jobs</b>	519,499	531,329	545,153	544,714	533,810
<b>%Chng Prior Year</b>	3.0%	2.3%	2.6%	-0.1%	-2.0%
<b>Mining</b>		2,235	2,336	2,171	1,877
<b>Construction</b>		34,199	34,636	33,755	30,552
<b>Manufacturing</b>		55,283	55,342	53,423	49,785
<b>Trade/Trans/Utilities</b>		114,010	118,505	119,204	115,894
<b>Information</b>		19,172	20,664	20,498	18,614
<b>Financial Activities</b>		39,797	41,268	43,764	43,768
<b>Profess/Business Svcs</b>		84,583	88,340	85,400	80,345
<b>Ed/Health/Social Svcs</b>		43,191	41,404	46,302	47,881
<b>Leisure/Hospitality</b>		42,741	43,923	43,821	45,909
<b>Other Services</b>		14,936	15,950	16,896	18,016
<b>Government</b>		81,182	82,785	79,480	81,087
<b>Total Establishments</b>	29,272	29,916	30,840	31,846	32,467
<b>Total Wages (\$Millions)</b>	15,168	16,152	17,407	17,322	17,857

Source: Utah Department of Workforce Services, Workforce Information.

Figure 9-2 Salt Lake Counties Largest Employers

<u>Establishment</u>	<u>Type of Business</u>
University of Utah *	State Government
State of Utah	State Government
Granite School District	Local Government
Jordan School District	Local Government
Salt Lake County	Local Government
Novus Services	Credit Services
Delta Airlines	Air Transportation
LDS Hospital	Hospital
Salt Lake City School District	Local Government
Salt Lake City Corporation	Local Government
U.S. Postal Service	Federal Government
Salt Lake Community College	State Government
United Parcel Service	Courier Service
Smith's Food & Drug	Grocery Stores
Zion's First National Bank	Bank
Qwest	Communications
Albertson's	Grocery Stores
Convergys	Telemarketing
Primary Childrens Medical Center	Hospital
Dick Simon Trucking	Trucking
Physicians Network	Doctor's Offices
Unibase Data Entry	Data Processing
Communications & Commerce	Telemarketing
Cottonwood Hospital	Hospital
Snowbird **	Ski Resort
CR England	Trucking
St. Marks Hospital	Hospital
VA Medical Center	Federal Hospital
L3 Communications	Manufacturing
Utah Transit Authority	Transportation
Wal-Mart	Department Stores
SkyWest Airlines	Air Transportation
American Express	Credit Services

\*Includes hospital

\*\*Seasonal peak

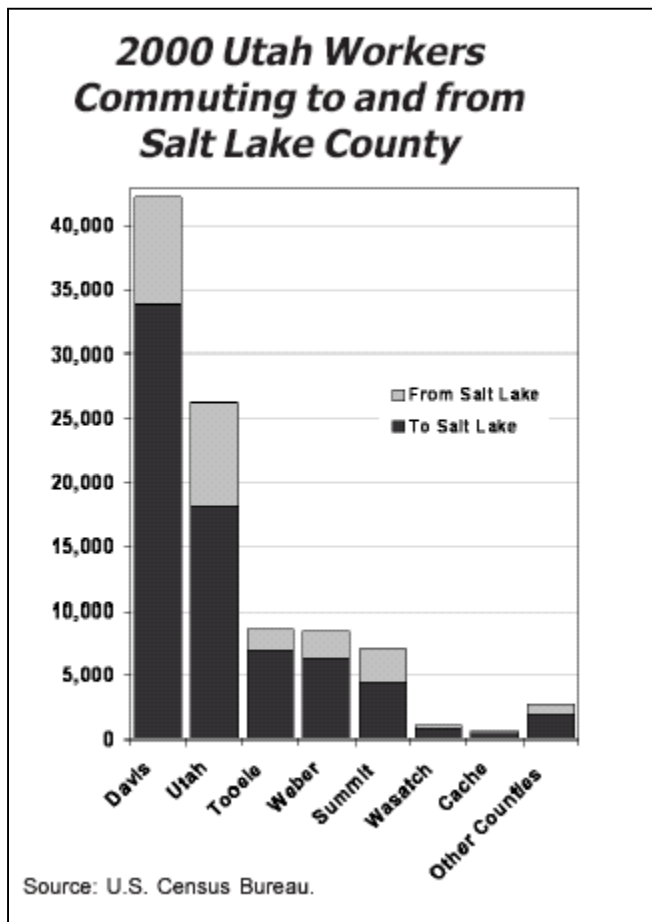
## C. Transportation and Commuting Patterns

The main highways in Salt Lake County include Interstate 15, Interstate 80, and Interstate 215 (Table 9-3). The US Census bureau has created a chart that identifies the commuting patterns of the larger urban areas within the State. Most of the workers living outside Salt Lake County but in the surrounding counties of Weber, Davis, Tooele, and Morgan commute into Salt Lake County each day, this totals 73,203 workers (Figure 9-3).

**Table 9-3 Major Artery Average Daily Traffic**

Artery Name	North-South	Entering	East-West	Exiting
I-15	181,562	Northern Co. Border		Southern Co. Border
I-80			43,182	
I-215 (Total= 1,567,518)	65,278	From I-15	67,240	From I-80

**Figure 9-3 Commuters**



## **D. Land Use**

Salt Lake County's land ownership is 72.8% Private, 20.4% Federal, 2.3% State, and 4.6% water. The county is ranked second in terms of the amount of private and local government ownership in the State of Utah.

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. According to the projections of the Wasatch Urban Area Long Range Transportation Plan: 2002-2030 are based on individual city and county land use assumptions, a majority of the region is expected to be developed for residential uses. Local master plans call for relatively low-density development patterns, with some pockets of denser activity. This pattern holds true for non-residential development as well as residential development. Large areas of industrial/warehouse development are planned in western Salt Lake City, along the I-15 corridor. High-density office and commercial developments are focused mainly in the Salt Lake and Ogden central business districts, with smaller commercial areas located in southern Salt Lake County. Additional, smaller nodes of commercial and retail development are expected to be dispersed throughout urban and rural portions of Salt Lake County.

A significant portion of Salt Lake County is currently zoned for low-density residential development. Some higher densities are allowed in eastern Salt Lake City, while the southeast and southwest areas of Salt Lake County are zoned for lower housing densities. Industrial land uses are planned for west Salt Lake City, along the I-15 corridor, northern West Valley City, the western portion of North Salt Lake, and the west side of Salt Lake County. Areas for commercial land uses include concentrations in Salt Lake City's central business district and along primary transportation corridors including I-15, I-215, State Street, 400 South, Highland Drive, 3500 South, 4500 South and 7200 South. Additional commercial land use nodes are dispersed throughout Salt Lake County to serve adjoining residential communities. An extension of the existing transportation network will provide needed highway and transit service to newly developed land. As land use changes, so will the type and size of facilities needed to meet increased travel demand. Certain areas of the region will remain undeveloped into the future even with projected high growth. Many of these public and private lands will remain undeveloped because of specific environmental constraints, such as steep slopes or prime wetlands. Some areas currently being used for industrial or mining activity are planned to be reclaimed for other uses. For example, Kennecott Utah Copper Corporation is planning a 12,000-unit, mixed use development on 4,500 acres that it owns in South Jordan. Higher population densities are projected to be concentrated in the currently developed areas with the recent development occurring at lower densities in the outlying areas.

Many of the cities and the county understand the importance of reducing the risk of natural hazards and have therefore already adopted codes, ordinances, and regulations. Such enforcements include earthquake-building codes and slope failure setback requirements. State and local agencies are joining forces with local communities to understand the risk of living in URWIN zones and the measures that can be taken to lessen the loss of life and property in the event of a wildland fire. Drought has been identified as a problem and most cities have taken the initiative to incorporate discounts or credits for using less water. Severe weather has always been a problem in this region and the response measures taken are kept up to date and include many mitigation measures. For examples of the identified measures refer to Part IV. Regional Data, Development Trends.

## **E. Risk Assessment**

A risk assessment hazard profile was completed for the following identified hazards; earthquake, severe weather, wildland fire, flood, dam failure, landslide, and drought. Severe weather and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 410 critical facilities in Salt Lake County. The recognized critical facilities include 5 Water Treatment Facilities, 2 Oil Facilities, 1 Natural Gas Facility, 6 Electric, 42 Communication, 291 Schools, 31 Police Stations, 16 Fire Stations, 1 Emergency Facility, and 15 Care Facilities. Refer to Appendix D for the complete list for the county.

# 1. Earthquake

## Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault movements. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

## Description of Location and Extent

The Wasatch Fault Zone is an active fault zone located in Salt Lake County. The Wasatch Fault is roughly 200 miles long and is broken down into ten segments that can rupture separately during earthquakes. There are six major segments of the Wasatch Fault, from north to south known as the Brigham City segment, Weber segment, Salt Lake City segment, Provo segment, Nephi segment, and the Levan segment. Within the Salt Lake City segment are three smaller segments from north to south known as Warm Springs Fault, Virginia Street Fault, and the East Bench Fault (Figure 9-4).

The Wasatch Fault Zone appears to be one of the most frequent sources of large earthquakes and because of the geologic conditions the secondary threats of earthquakes are high. Recent evaluation of the earthquake potential along the Wasatch Front indicated that a normal fault zone earthquake could measure in excess of 7 on the Richter scale and could happen about once every 300-400 years.

The secondary threats associated with an earthquake include ground shaking, liquefaction, lateral spread, and surface fault rupture. Of these threats the county is most subject to ground shaking and liquefaction.

Ground shaking is most severe in areas of deep thick sediment, which in the case of the Wasatch Front is the entire Salt Lake Valley. Generally, the thicker the sediments the greater the shaking will be. Peak Ground Acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration do to gravity. The following Figures 9-5, 9-6, and 9-7 developed by Ivan Wong illustrate the amount of ground acceleration expected in different areas of Salt Lake Valley based on a 7.0 magnitude earthquake. According to Sandra Eldredge, a magnitude 7.0 and 7.5 earthquake would create surface fault rupture with a displacement between 16 to 30 feet high and break segments 12 to 44 miles long.

Liquefaction is also severe due to the high water table and sandy ancient lakebed sediments that makeup the valley floor. There is a greater than 50% probability of having an earthquake within a 100 year period strong enough (over 5.0 Richter magnitude) to cause liquefaction (Figure 9-8).

Historically, the last major earthquake to hit Salt Lake City occurred approximately 1350 years ago. According to Eldredge, the Wasatch Fault segments between Brigham City and Nephi have a composite recurrence interval for a large earthquake (magnitude 7.0 to 7.5).

**Figure 9-4 Fault Lines**

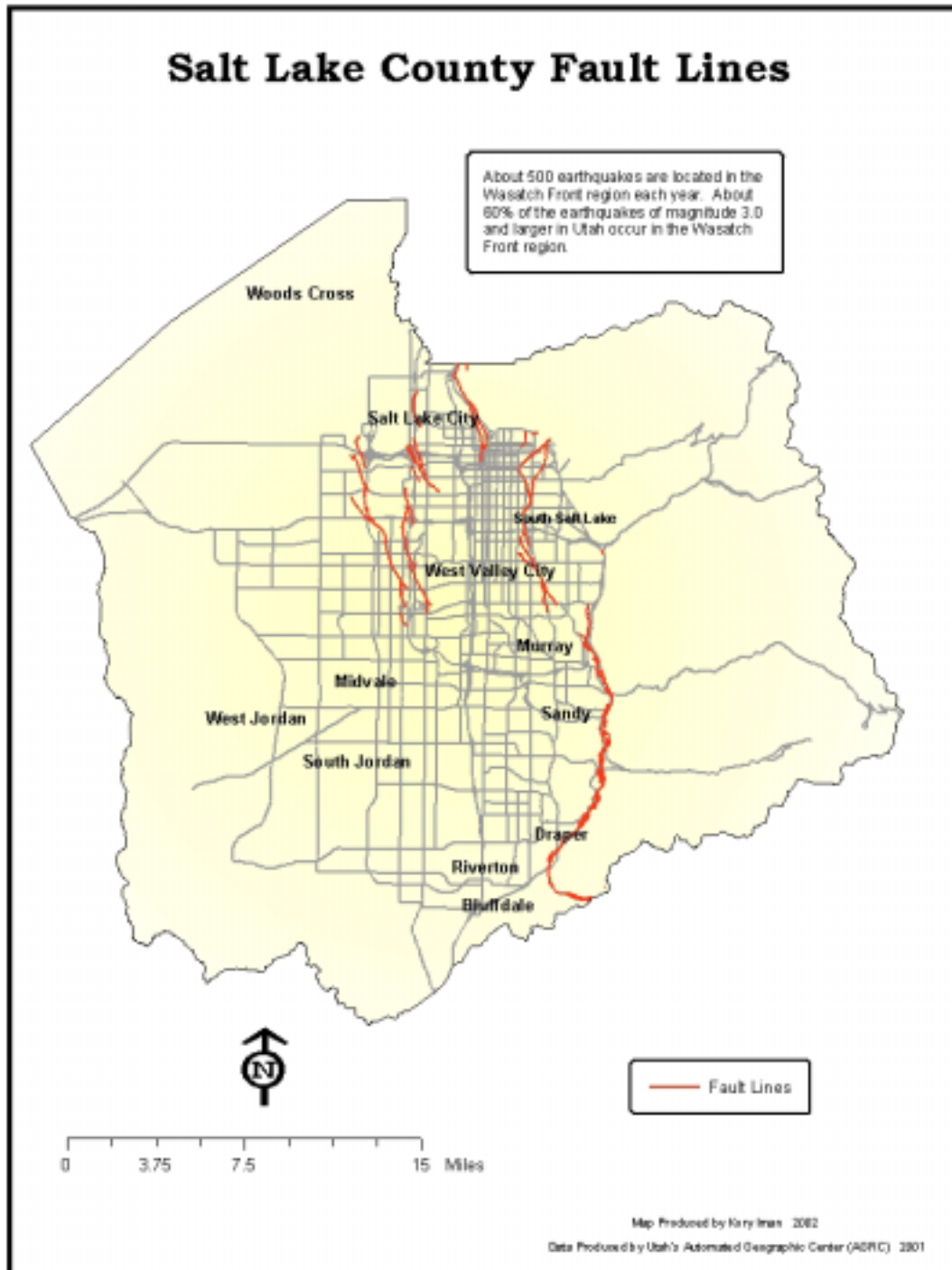


Figure 9-5 PGA Values

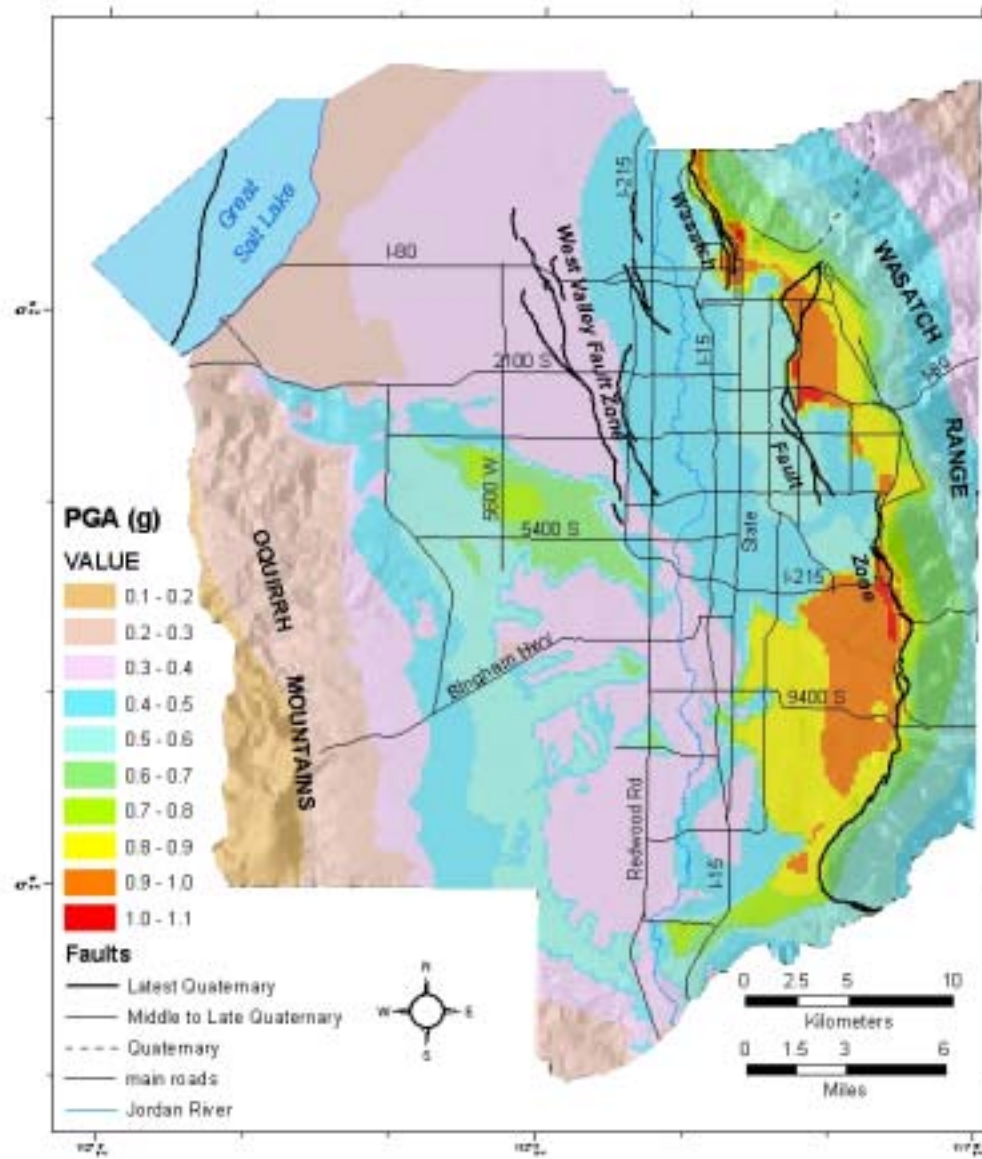


Figure 1. Salt Lake City segment, Wasatch Fault, M7.0 earthquake scenario: Peak horizontal acceleration (g) at the ground surface. From Wong, et al., 2001.

Figure 9-6 Salt Lake City 0.2 PGA Values

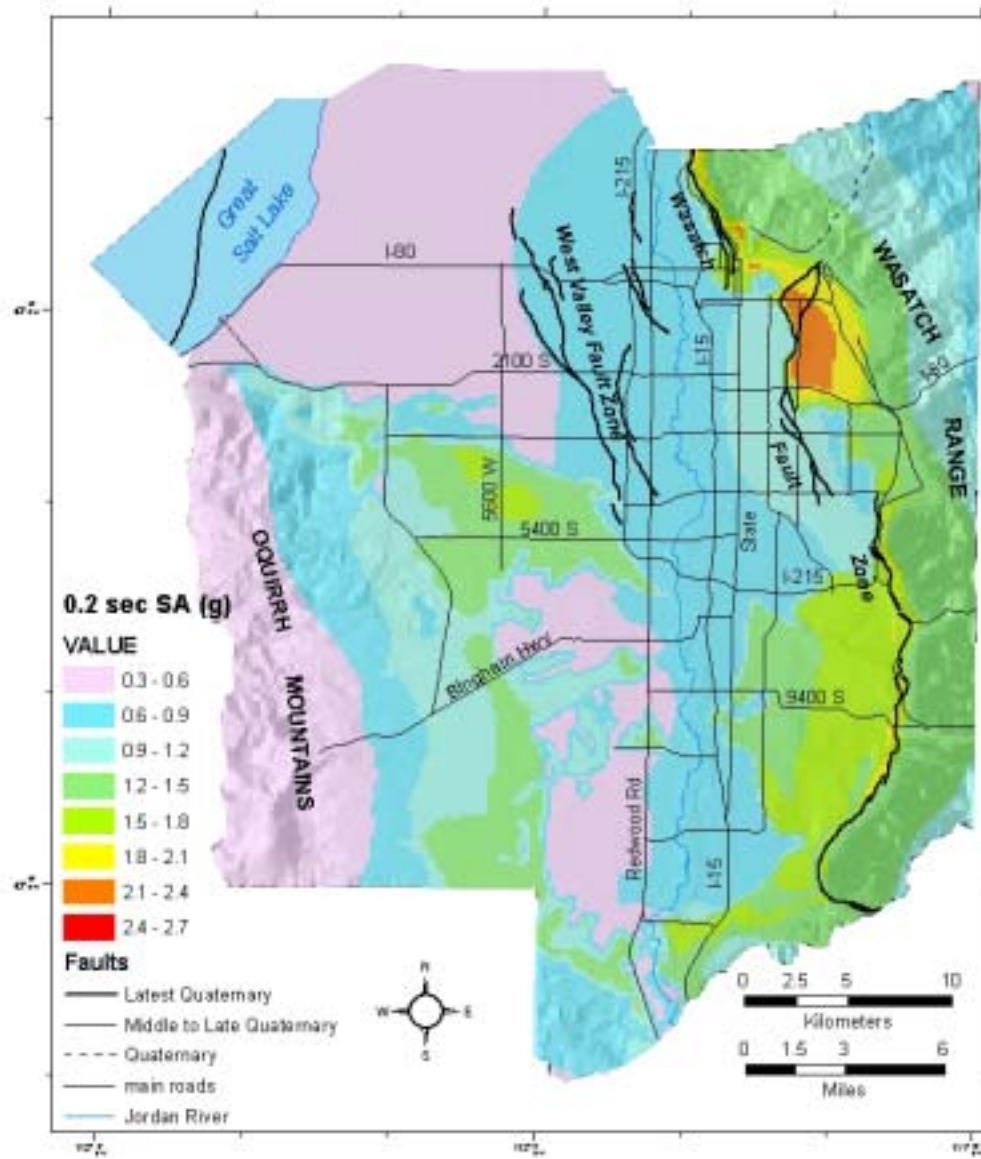


Figure 2. Salt Lake City segment, Wasatch Fault, M7.0 earthquake scenario; 0.2 second spectral acceleration (g) at the ground surface. From Wong, et al., 2001.

Figure 9-7 Salt Lake City 1.0 PGA Values

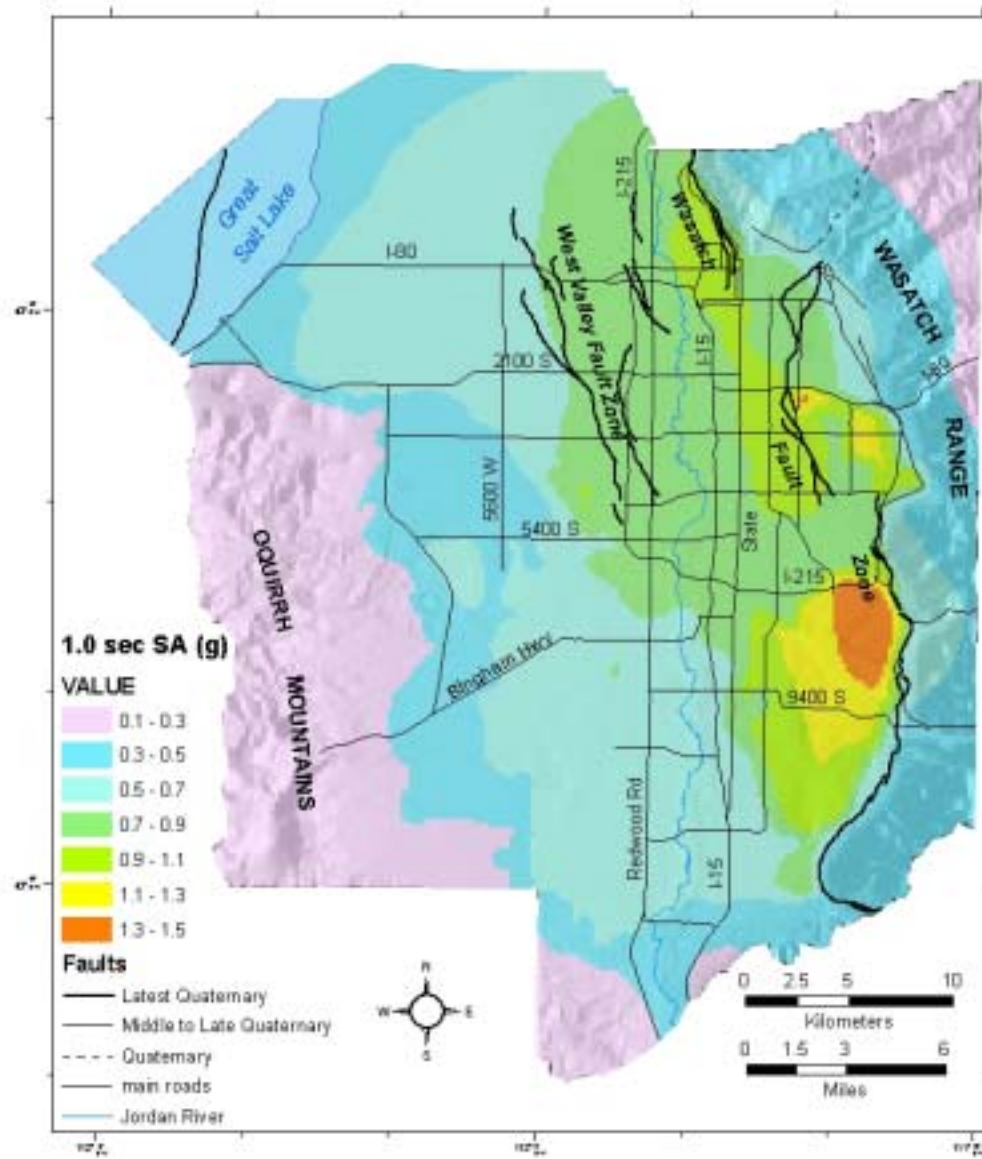
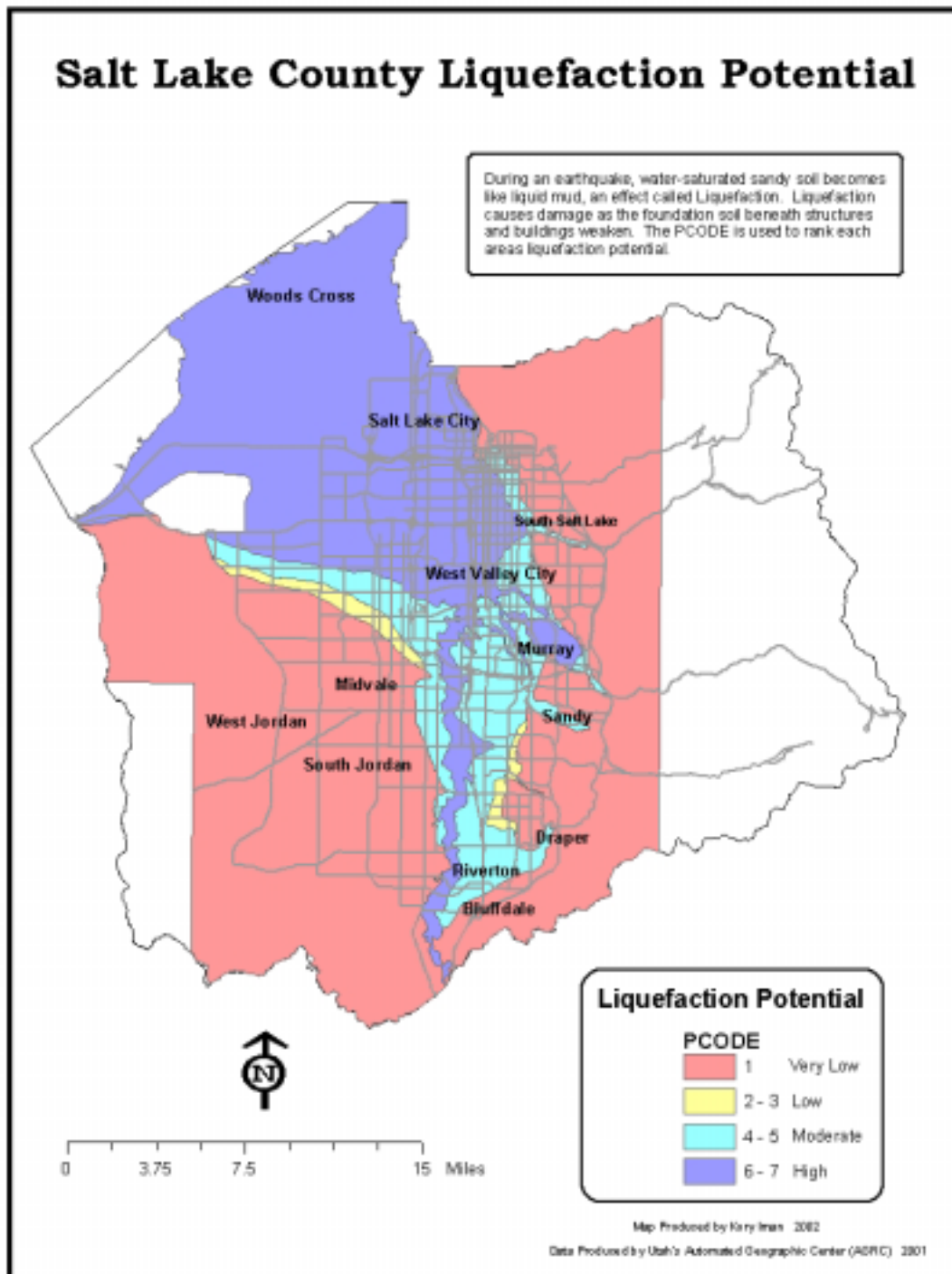


Figure 3. Salt Lake City segment, Wasatch Fault, M7.0 earthquake scenario: 1.0 second spectral acceleration (g) at the ground surface. From Wong, et al., 2001.

Figure 9-8 Liquefaction Potential



### Vulnerability Assessment

Refer to Tables 9-9, 9-10, and 9-11 for the inventory of people, property, and other infrastructure located within the identified earthquake fault zones. Refer to Appendix I for the list of critical facilities within the earthquake fault zones as well as the liquefaction zones.

**Table 9-9 Property Inventory within Fault Zones**

City Name	City Area (Acres)	Acres in Fault Zone	Acres in Liquefaction Zone	Number of property structures within Fault Zones		Number of Structures within Liquefaction Zones		Population in Hazard Areas	
				Commercial/ Annual Sales	Residential/ Value	Commercial/ Annual Sales	Residential/ Value	Earthquake	Liquefaction
Alta	2,623	0	0	0	0	0	0	0	0
Bluffdale	10,543	0	1,818	0 / \$0	0 / \$0	25 / \$30,600,000	116 / \$16,699,590	0	492
Draper	14,187	4,125	6,060	67 / \$43,300,000	1,379 / \$364,034,940	755 / \$14,115	2,903 / \$478,415,790	3,223	4,108
Herriman	7,744	0	0	0	0	0	0	0	0
Holladay	3,235	2,882	1,295	564 / \$380,700,000	4,018 / \$866,261,690	143 / \$93,200,000	1,025 / \$303,784,480	13,870	3,460
Midvale	3,840	0	3,822	0	0	1,949 / \$2,514,500,000	6,151 / \$673,324,410	0	31,569
Murray	6,690	0	6,686	0	0	3,190 / \$7,252,700,000	10,714 / \$1,280,966,290	0	54,968
Riverton	8,044	0	400	0	0	14 / \$3,500,000	477 / \$83,332,570	0	1,869
Salt Lake City	70,938	38,857	45,306	7,871 / \$15,918,200,000	39723 / \$5,696,835,420	8,827 / \$177,176	24,414 / \$2,164,509,820	157,7212	106,264
Sandy	14,367	2,983	4,287	158 / \$145,300,000	2,655 / \$664,122,660	1,774 / \$2,802,300,000	5,550 / \$624,844,790	18,145	25,336
South Jordan	14,150	0	2,602	0	0	203 / \$781,900,000	1,395 / \$270,539,660	0	8,205
South Salt Lake	4,409	496	4,409	144 / \$168,700,000	1,298 / \$119,392,100	2,614 / \$47,997	4,318 / \$372,589,610	7,332	27,524
Taylorsville	6,963	1,755	4,260	303 / \$390,500,000	3,923 / \$414,570,64	755 / \$1,199,400,000	7,510 / \$811,362,050	17,696	43,056
West Jordan	20,448	0	2,972	0	0	591 / \$749,100,000	4,381 / \$467,682,890	0	18,902
West Valley	22,808	6,489	14,085	1,883 / \$6,777,100,000	9,209 / \$850,608,020	2,618 / \$8,581,900,000	19,140 / \$1,813,906,940	45,972	89,463
Un- Incorporated	304,953	22,008	56,423	3,603 / \$4,711,000,000	28,433 / \$4,546,764,370	3,013 / \$3,950,500,000	18,338 / \$2,205,379,610	102,835	96,902

**Table 9-10 Infrastructure affected by Liquefaction**

Item	Length (Miles)	Replacement Cost
Local Roads	44.7600	\$89,520,000
State Highways	122.4990	\$295,651,337
US Highways	14.2038	\$34,280,871
US Interstates	64.5455	\$232,363,800
Power Lines	771.17	\$37,232,088

**Table 9-11 Infrastructure affected by Earthquake Fault Zones**

Item	Length (Miles)	Replacement Cost
Local Roads	4.22	\$8,430,400
State Highways	76.60	\$184,882,065
US Highways	5.07	\$12,224,619
US Interstates	34.48	\$124,130,160
Power Lines	222.25	\$10,730,230
Gas Lines	60.18	\$14,526,850

**HAZUS MH Vulnerability Assessment**

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 9-12 identifies the probable casualties during an earthquake.

**Table 9-12 Casualties**

<b>Casualties</b>	Nighttime –Minor	14,162
	Nighttime –Major	392
	Nighttime -Fatalities	756
	Daytime –Minor	21,828
	Daytime –Major	872
	Daytime- Fatalities	1,689
	Commute –Minor	17,772
	Commute –Major	660
	Commute-Fatalities	1,259

**Building Damage by Count**

Building damage is classified by HAZUS MH in five damage states: none, slight, moderate, extensive and complete. Table 9-13 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage. Table 9-14 identifies the critical facilities that would be affected by an earthquake.

**Table 9-13 Building Damage by Count with Moderate to Complete Damage**

<b>Category</b>	<b>Number of Structures</b>
Residential	16,528
Commercial	3,220
Industrial	485
Totals	169,144*

\*Includes all building categories with moderate to complete damage

**Table 9-14 Critical facilities**

<b>Classification</b>	<b>Total</b>	<b>Least Moderate Damage &gt;50%</b>	<b>Complete Damage &gt; 50%</b>	<b>Functionality &gt; 50% at day 1</b>
Hospitals	15	15	0	0
Schools	291	276	0	0
Emergency Operation Centers	1	0	0	1
Police Stations	31	30	0	0
Fire Stations	16	14	0	0

**Debris Removal**

Table 9-15 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

**Table 9-15 Debris Generated (millions of tons)/Loads to Remove Debris**

Debris Generated	9
Loads (25 tons per load)	360,000

**Fire Following**

The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS MH uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9-16 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

**Table 9-16 Fire Following Event, Population Exposed, and Building Stock Exposed**

Ignitions	95
People Displaced	2,631
Value Exposed (mill. \$)	138

## 2. Wildland Fire

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

### Description of Location and Extent

The portions of Salt Lake County that could experience the most significant amount of destruction due to a wildland fire include the foothills and the bench areas on or near the Wasatch Front Mountain Range. These URWIN areas are threatened most because of the amount of forested lands and the increasing population growth spreading into the foothills. Another concern is the type of vegetation in these areas that burns easily, such as sagebrush, mountain shrub, pinion and juniper trees, and rural and riparian vegetation. Sagebrush burns hot and fast and spreads easily, and is found throughout the county. Mountain shrub also burns hot and fast and is one of the more dense types of vegetation throughout the county. During prime burning conditions (hot, dry, and windy) the pinion juniper class will burn.

As the population growth continues development in URWIN areas will also continue. This will dramatically increase the threats associated with fire and mitigation measures will need to be recognized and enforced.

The wildfire threat in Salt Lake County in the past has had a significant affect on the watersheds, including slope failure, debris flows, and other forms of erosion. State and local Agencies have worked together to enforce ordinances and other programs such as re-vegetation zones to protect county watersheds in the past.

Wildfire maps were created using GIS and can be viewed in Section H, Map 9.2.1 Salt Lake County Wildfire Risk. The map layers were provided by DESHS and show three categories of wildfire risk:

- Extreme
- High
- Medium

These ratings cover all of Salt Lake County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

### Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population and history can also be viewed in the following tables (Table 9-17, 9-18, 9-19). Due to the large extent of data please refer to Appendix I Salt Lake County critical facilities affected by hazards.

**Table 9-17 Wildfire Risk Assessment**

City Name	City Area (Acres)	Acres in Wildfire Area			Number of Structures within Wildfire Area		Population in Hazard Area
		Extreme	High	Moderate	Residential/ Replacement Value	Commercial/ Annual Sales	
Alta	2,623	186	1098	746	194 / \$91,726,710	0	677
Bluffdale	10,543	291	4440	496	87 / \$17,594,660	17 / \$24,900,000	532
Draper	14,187	.5	2,444	3911	2,667 / \$612,538,980	103 / \$78,500,000	5,571
Herriman	7,744	229	1,569	2,382	825 / \$110,359,550	116 / \$77,200,000	1,265
Holladay	3,235	0	0	0	0	0	0
Midvale	3,840	0	0	0	0	0	0
Murray	6,690	0	0	0	0	0	0
Riverton	8,044	0	0	193	447 / \$52,301,400	11 / \$7,800,000	1,366
Salt Lake City	7,0938	70	1,234	9,479	373 / \$169,550,700	54 / \$108,200,000	1,305
Sandy	14,367	0	345	880	169 / \$79,436,700	11 / \$364,000,000	569
South Jordan	14,150	0	0	2,730	0	0	0
South Salt Lake	4,409	0	0	0	0	0	0
Taylorsville	6,963	0	0	0	0	0	0
West Jordan	20,448	0	0	222	0	0	0
West Valley	22,808	0	0	2,508	0	40 / \$480,300,000	0
Un-Incorporated	304,953	2,434	35,452	36,470	679 / \$165,498,160	94 / \$192,900,000	1,020

**Table 9-18 Infrastructure Affected by Wildfire**

Item	Length (Miles)	Replacement Cost
Local Roads	2.55	\$5,108,000
State Highways	13.66	\$32,967,927
US Highways	1.35	\$3,264,259
US Interstates	9.29	\$33,432,840
Power Lines	56.80	\$2,742,304
Gas Lines	11.20	\$2,703,568

**Table 9-19 Wildfire History**

Date	Fire Name	Cause	Size
7/18/87	Camp Williams 5	Incendiary	300-999 Acres
9/2/88	Affleck Park	Miscellaneous	>5000 Acres
7/16/01	Beef Hollow	Equipment	>5000 Acres

### 3. Flood

#### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Flooding would mainly occur in and along floodplains. See map in Section H.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

#### Description of Location and Extent

Flooding in Salt Lake County is similar to the rest of the region in that it is the result generally of snowmelt runoff, or cloudburst storms. Snowmelt flooding is the result of rapid melting of snowpack and occurs between April through June. Cloudburst rainstorms are high intensity short duration storms that occur over a relatively small area in the summer months. However, flooding can occur from any precipitation event.

The major waterways in the county include the Jordan River, Big and Little Cottonwood Creeks, Parleys Creek, Emigration Creek, Red Butte Creek, City Creek, Lambs Creeks, Dell Creek, and Millcreek. All have the potential to flood. However, due to the flooding of the early 1980's and other flood events, flood mitigation measures were incorporated that significantly reduces the flood threat. The flows of the Jordan River are controlled and so the flood threat is very low. Parleys Creek has flood storage capacity at Mountain Dell and Little Dell Reservoirs and is routed through a retention basin in Sugarhouse Park. Big and Little Cottonwood Canyons, and Bells Canyon have a number of smaller flood storage lakes and ponds. But not all are regulated and they offer minimal flood protection. In Salt Lake City, Parleys Creek, Emigration Creek, and Red Butte Creek have all been routed to come together at Liberty Park. Retention ponds are also used to store runoff from commercial and residential development areas (Figure 9-12).



\*On September 29, 1982, floodwaters destroyed portions of the road near the Storm Mountain area of Big Cottonwood Canyon east of Salt Lake City. The flooding occurred after several days of heavy rains brought on by tropical moisture that moved into the state from dying hurricane Olivia and the energy supplied from an active cold front. (Photo by David Carpenter.) Source: [http://www.utahweather.org/UWC/weather\\_pictures/weather\\_photos\\_1900-2002.html](http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html).

**Figure 9-12 Salt Lake County Rivers**



The following table identified the daily average cubic feet per second flow of the streams within Salt Lake County from 1900 to 1999, according to the Salt Lake City Multi-Hazard Mitigation Plan of 2002 (Table 9-20). Flooding within the county in the past has been recorded, Table 9-21 details the flood event.

**Table 9-20 Daily Average CFS**

Watershed Area in Square Miles	Stream in Order of Peak Date	Yearly Average in Cubic Feet Per Second (cfs *)	Usual Runoff Peak in cfs	Average Peak Date
18.0	Emigration	6.53 cfs	24.27 cfs	May 7 <sup>th</sup>
23.1	Dell	11.45 cfs	63.16 cfs	May 16 <sup>th</sup>
19.7	Lamb's	12.32 cfs	40.29 cfs	May 27 <sup>th</sup>
21.7	Millcreek	15.52 cfs	44.78 cfs	May 28 <sup>th</sup>
19.2	City Creek	16.81 cfs	56.24 cfs	May 29 <sup>th</sup>
48.5	Big Cottonwood	74.45 cfs	292.8 cfs	June 6 <sup>th</sup>
27.4	Little Cottonwood	64.46 cfs	289.0 cfs	June 14 <sup>th</sup>

Tributaries of Parleys Creek, data compiled 1970 through 1999. Study done by Dan Schenck Salt Lake City Hydrologist.

\*cfs- cubic feet per second

**Table 9-21 Flood Events**

Flood Year	Stream	Discharge* (cfs)	Estimated Return Interval (Years)
1909	Parleys Creek	247	18
1917	City Creek	105	7
	Emigration Creek	64	8
	Parleys Creek	242	11
1922	City Creek	118	13
	Emigration Creek	110	33
	Parleys Creek	317	40

1952	City Creek	127	20
	Emigration Creek	156	100
	Parleys Creek	365	100

\*Discharges given in mean daily values actual peak flows would have been somewhat higher. From Salt Lake City Flood Insurance Study.



\*During the past 149 years, the Great Salt Lake has peaked three times at 4,211 feet above sea level: 4,211.60 feet in June 1873, 4,211.50 feet in June 1986, and 4,211.60 feet in June 1987. This picture of the Saltair Resort on the southeast shore of the Great Salt Lake was taken during the flood years of the 1980's. Large pumps were installed on the west side of the Great Salt Lake (at a cost of \$60 million) and began pumping water into the west desert in 1987. These pumps now make it possible for man to control the level of the lake. (Photo courtesy of the National Weather Service.) Source: [http://www.utahweather.org/UWC/weather\\_pictures/weather\\_photos\\_1900-2002.html](http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html).

### **Vulnerability Assessment**

Although, this plan discusses flood potential and shows history of flooding and contains corresponding mitigation strategies to deal with flood prone areas the reader needs to understand that a detailed survey of risk and capability shows that Utah has relatively little flood risk. This is due in part to the dry climate, but due in large to flood mitigation that occurred in the early 1980's. Some of these recent measures include the Salt Lake County Flood Control Project, City Storm Drainage Master Plans, SNOTEL Sites, NFIP Community Rating System, City Watershed Plans, Retention ponds, Detention basins, and regular Dam Inspections.

The following tables identify the number of residential and commercial property within the 100-year floodplain along with the population (Table 9-22). Critical facilities that lie within the 100-year floodplain have also been assessed. Due to the large extent of data please refer to Appendix I Salt Lake County critical facilities affected by hazards. Refer to Map 9.3.1 for the location of the 100- year floodplains within the county. Salt Lake City was a Utah Project Impact Community in 1999 and analyses from this study were added into the State Hazard Mitigation Plan and reviewed for the making of this plan.

**Table 9-22 Floodplain Risk Assessment**

City Name	City Area (Acres)	Acres in 100 Year Flood Plain	Number of Structures within 100 Year Floodplain		Population in Hazard Area
			Residential / Replacement Value	Commercial/ Annual Sales	
Alta	2,623	3	0	0	0
Bluffdale	10,543	179	11 / \$5,628,290	1 / \$100,000	35
Draper	14,187	293	172 / \$48,378,260	38 / \$22,400,000	550
Herriman	7,744	204	71 / \$14,128,210	1 / \$300,000	227
Holladay	3,235	43	19 / \$14,681,820	25 / \$9,600,000	61
Midvale	3,840	32	8 / \$654,400	18 / \$32,400,000	26
Murray	6,690	170	196 / \$30,533,950	61 / \$56,100,000	568
Riverton	8,044	361	210 / \$43,393,200	11 / \$7,400,000	609
Salt Lake City	70,938	2,975	459 / \$66,013,850	353 / \$941,800,000	1,331
Sandy	14,367	201	141 / \$37,322,340	15 / \$11,600,000	409
South Jordan	14,150	786	378 / \$99,249,270	25 / \$11,800,000	1,096
South Salt Lake	4,409	281	165 / \$18,299,500	84 / \$187,400,000	528
Taylorsville	6,963	141	93 / \$22,173,160	2 / \$900,000	307
West Jordan	20,448	717	287 / \$77,460,590	96 / \$153,200,000	947
West Valley	22,808	715	335 / \$49,542,360	85 / \$588,100,000	1,106
Un-Incorporated	304,953	56,806	861 / \$234,634,650	92 / \$159,100,000	2,238

### 3. Dam Failure

#### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Dam locations are mainly in the eastern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

#### Description of Location and Extent

Twenty-eight High Hazard dams are located in Salt Lake County, according to the Utah Division of Water Rights, Dam Safety Inspection agency. A high hazard threat means if the dam were to fail it would have a high probability of causing loss of life and extensive economic loss. The county also has fifteen moderate hazard dams; meaning if the dam were to fail it would have a low probability of causing loss of life but would cause appreciable property damage. Seventy-two dams have a low hazard threat, if the dam were to fail there would be a minimal threat to life and economic losses would be minor. The damage would be limited to the owner of the dam, however they should still be monitored. Refer to Table 9-23 for a listing of the high hazard dams within the county. Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State Engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

**Table 9-23 High Hazard Dams**

Dam Name	
Ensign Downs Db (Victory Road Db)	Salt Lake County Federal Heights (#1a)
Kennecott Mine Bingham Creek	Salt Lake County School Pond (#14)
Lake Mary-Phoebe	Salt Lake County Shriner's (#12)
Little Dell	Salt Lake County-Rotary Glen Park
Mountain Dell	Sandy City - Alta Canyon
Red Butte Dam	Sandy City - Buttercup
Red Pine	Sandy City - East Sandy Elementary
Riverton City - 3200 West Pond	Sandy City -Willow Creek
Riverton City - 4200 West Pond	Sandy City-Falcon Db
Salt Lake C0-Creepside Park (Big Cottonwood)	Sandy City-Flat Iron Mesa
Salt Lake Co.-Big Cottonwood (Spencer's)	Sandy City-Storm Mountain Db
Salt Lake County - Scott Avenue	South Jordan RDA Db
Salt Lake County - Sugarhouse	Twin Lakes (Salt Lake)
Salt Lake County Chandler Drive (#13)	White Pine

### Vulnerability Assessment

The following identifies the number of people, property, and other infrastructure that could be affected in the event of a dam failure as well as the replacement values (Table 9-24). A break on most of the dams listed would cause localized flooding and property loss to the facilities and property down stream and/or down slope from the dam.

**Table 9-24 Dam Failure Risk Assessment**

City Name	City Area (Acres)	Acres in Dam Failure Area	Number of Structures within Dam Failure Area		Population in Hazard Area
			Residential / Replacement Value	Commercial/ Annual Sales	
Alta	2,623	166	84 / \$50,534,080	0	69
Bluffdale	10,543	206	104 / \$16,910,230	2 / \$300,000	302
Draper	14,187	0	0	0	0
Herriman	7,744	0	0	0	0
Holladay	3,235	632	393 / \$162,157,070	62 / \$35,000,000	677
Midvale	3,840	653	42 / \$3,256,700	272 / \$545,900,000	158
Murray	6,690	2,513	3,790 / \$480,359,620	1,130 / \$1,376,500,000	13,184
Riverton	8,044	0	0	0	0
Salt Lake City	70,938	42,183	17,842 / \$1,526,780,840	4,918 / \$11,310,600,000	76,198
Sandy	14,367	590	404 / \$46,652,930	65 / \$484,400,000	1,790
South Jordan	14,150	374	102 / \$15,321,400	3 / \$2,000,000	430
South Salt Lake	4,409	2,266	314 / \$23,632,570	1,131 / \$2,313,400,000	967
Taylorsville	6,963	810	1,007 / \$113,414,700	70 / \$168,200,000	4,498
West Jordan	20,448	2,140	1,917 / \$231,124,980	284 / \$459,400,000	7,114
West Valley	22,808	5,124	2,198 / \$199,677,310	1,195 / \$5,317,100,000	7,912
Un-Incorporated	304,953	39,684	5,369 / \$896,609,230	1,093 / \$1,499,800,000	26,366

## 4. Landslide / Slope Failure

### Hazard Profile

Potential Magnitude	X	Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer months usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

### Description of Location and Extent

Landslides and debris flows are most common in the foothills along the base of the Wasatch Mountain Range from wet climatic conditions. Landsliding occurs in areas of pre-existing landslides. Some major landslide areas include the Grand View Peak rockslide in upper City Creek Canyon, the Baskin Spring landslide in North Salt Lake, the Little Valley Red Rock landslide in Draper, and the shallow disrupted landslides in and near Steep Mountain in Draper. As urbanization is spreading into geologically unstable areas of the county the risk to life and property is increased.

The Grand View Peak slide is a candidate for an earthquake-induced landslide. The Baskin Spring slide is a prehistoric slide on the northern flank of the Salt Lake salient. This slide also has a strong susceptibility to seismic failure. The Little Valley Red Rock slide in Draper is the largest in southern Salt Lake County. The Draper Heights landslide is a post Lake Bonneville slide that occurred on the steep north slope of Steep Mountain. This slide is an earthquake triggered soil slide.

### Vulnerability Assessment

The following tables identify the people, property and infrastructure affected by a landslide (Tables 9-25 and 9-26).

**Table 9-25 Landslide Risk Assessment**

City Name	City Area (Acres)	Acres in Landslide Area	Number of Structures within Landslide Area		Population in Hazard Area
			Residential/Replacement Value	Commercial/Annual Sales	
Alta	2,623	41	7 /\$3,730,530	0	0
Bluffdale	10,543	0	0	0	0
Draper	14,187	0	0	0	0
Herriman	7,744	0	0	0	0
Holladay	3,235	556	846 /\$253,001,890	42 /\$18,900,000	2,565
Midvale	3,840	0	0	0	0
Murray	6,690	0	0	0	0
Riverton	8,044	0	0	0	0
Salt Lake City	70,938	658	924 /\$301,456,800	86 /\$116,400,000	3,370
Sandy	14,367	0	0	0	0
South Jordan	14,150	0	0	0	0
South Salt Lake	4,409	0	0	0	0
Taylorsville	6,963	0	0	0	0
West Jordan	20,448	0	0	0	0
West Valley	22,808	0	0	0	0
Unincorporated	304,953	2,592	3,208 /\$922,336,300	263 /\$279,000,000	7,635

**Table 9-26 Infrastructure Affected by Landslide**

Item	Length (Miles)	Replacement Cost
Local Roads	0.31	\$624,800
State Highways	1.69	\$4,067,713
US Highways	0.00	\$0
US Interstates	3.32	\$11,948,400
Power Lines	3.22	\$155,462
Gas Lines	3.60	\$869,004

## F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Table 9-27 identifies historic events with as much relevant information as was available including date, location, area impacted, and damage costs.

**Table 9-27 Hazard History**

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Avalanche	04/01/1864	Mill Creek Canyon		2 deaths.
Avalanche	02/15/1865	City Creek Canyon		4 deaths.
Avalanche	04/01/1869	Mill Creek Canyon		3 deaths.
Avalanche	02/05/1872	Big Cottonwood Canyon		2 deaths.
Avalanche	12/26/1872	Little Cottonwood Canyon		10 deaths. Property damage.
Avalanche	01/11/1875	Little Cottonwood Canyon		4 deaths. Property damage.

Avalanche	01/19/1875	Big Cottonwood Canyon		6 deaths. Property damage.
Avalanche	01/20/1875	Big Cottonwood Canyon		6 deaths. Property damage.
Avalanche	03/03/1875	Big Cottonwood Canyon		1 death.
Avalanche	12/25/1875	Little Cottonwood Canyon		1 death. Property damage.
Avalanche	12/29/1876	Little Cottonwood Canyon		2 deaths.
Avalanche	03/11/1877	Little Cottonwood Canyon		2 deaths.
Avalanche	01/12-17/1881	Little Cottonwood Canyon/ American Fork Canyon		15 deaths. Property damage.
Avalanche	02/17/1882	Big Cottonwood Canyon		7 deaths. Property damage.
Flood	09/29/1882	Big Cottonwood Canyon	Storm Mountain	Road damage.
Avalanche	03/07/1884	Little Cottonwood Canyon		12 deaths.
Avalanche	02/12-13-1885	Bingham Canyon/ Little Cottonwood Canyon		17 deaths. Property damage.
Avalanche	03/02/1889	Little Cottonwood Canyon		15 deaths. Property damage.
Avalanche	01/17/1899	City Creek Canyon		Property damage.
Avalanche	02/08/1899	Bingham Canyon, Big Cottonwood Canyon		2 deaths. Property damage.
Avalanche	01/20/1906	Little Cottonwood Canyon		6 deaths. Property damage.
Avalanche	01/31/1911	Big and Little Cottonwood Canyons		4 deaths. Property damage.
Flood	08/02/1922	Magna		1 death, property damages.
Flood	08/13/1923			Intense thunderstorms, 7deaths, and \$3,000,000 damage.
Drought	1930-1936	Countywide		
Avalanche	02/09/1939	Bingham Canyon		4 deaths
Avalanche	01/01/1941	Alta Ski Area		1 death
Avalanche	03/21/1943	Big Cottonwood Canyon		1 death
Flood	08/19/1945	Salt Lake City	Perry's Hollow	Severe Storm/ Heavy rainfall. \$500,000 damage to homes and cemetery.
Severe Storm	1948-1949	Salt Lake Valley		Heavy snow, severe cold, high winds.

Flood	08/9-10/1949	Bingham		Heavy rainfall. Residential and commercial damages, over \$9,000.
Avalanche	03/27/1950	Little Cottonwood Canyon		1 death
Flood	04/23/1951	Salt Lake City	West side of city.	Residential damages.
Flood	07/27/1951	Salt Lake City/ Bingham	Flash flood between Bingham and Copperton.	Severe Storm. Extensive property damage and highway washed out.
Flood	08/03-04-1951	Magna		Homes destroyed.
Flood	08/04/1951	Salt Lake City		Heavy cloudburst storm. Residential and business damages.
Landslide	08/04/1951	Salt Lake City	City Creek Canyon	From cloudburst storm.
Flood	April 27-June 30 1952	Ogden, Weber, and Jordan Rivers	Disaster Declared. Parleys, Emigration, and Red Butte Canyons.	Snowpack melt. 2 deaths. \$8.4 million damage to streets, homes, and power.
Earthquake	07/23/1952	Salt Lake City		Richter magnitude 3.7
Earthquake	05/24/1953	Salt Lake City		Richter magnitude 4.3
Earthquake	08/16/1953	Salt Lake City	Rose Park	Richter magnitude 3.7
Earthquake	02/02/1955	Salt Lake City		Richter magnitude 4.3
Drought	1953-1965	Countywide		
Flood	07/26/1955	Bingham	Bingham Canyon	Damage to homes and streets.
Flood	08/06/1955	Salt Lake City/ Herriman/ Riverton		Thunderstorms damaged homes, farms, and streets.
Flood	08/01/1961	Salt Lake City	Big Cottonwood Creek	Washed out Big Cottonwood Canyon Road.
Earthquake	09/05/1962	Magna		Richter magnitude 5.2
Flood	08/31/1963	Magna	Reported worst storm in 20 years.	Residential, commercial, and roads damaged.
Flood	09/21/1963	Salt Lake City		Heavy rain. Streets, property, Highland High School, Hall of Justice construction all damaged.
Tornado	02/09/1965			F2

Flash Flood	07/30/1965	Neff's Canyon		Flash Flood. Damage to homes, roads, sewer, and water lines.
Flood	08/19/1965	Midvale		Severe Storm. Damage to homes.
Flood	09/05-07/1965	Midvale		Heavy rain. Damage to homes and streets.
Flood	06/07/1966	Holladay		Cloudburst storm. \$10,000 damage to homes.
Avalanche	02/12/1967	Grandeur Peak		2 deaths.
Lightning	06/16/1967	Copperton		1 death.
Flood	07/21/1968	Midvale/ Riverton/ Murray		Heavy rain. Damage to homes and crops.
Tornado	08/14/1968			F1
Earthquake	01/23/1969	Emigration Canyon		Richter magnitude 3.0
Flood	07/29/1969	Salt Lake City	Little and Big Cottonwood Canyons.	Severe Storm. Damaged roads and block Big Cottonwood.
Flood	08/17/1969	Salt Lake City	East Bench	Thunderstorm. Damage to homes. Dam failure flooded more homes.
Avalanche	01/29/1970	Alta Ski Area		1 death.
Earthquake	09/17/1971	Near Alta		Richter magnitude 3.2
Earthquake	09/19/1971	Near Alta		Richter magnitude 3.3
Lightning	08/02/1972	Riverton		1 death.
Avalanche	12/30/1973	Alta Ski Area		Property damage.
Avalanche	01/05/1976	Alta Ski Area		1 death
Drought	1974-1978	Countywide		
High Winds	04/04-06/1983	Wasatch Front Region		Over \$8 million in damage.
Flood	April-June 1983	Great Salt Lake and tributaries between Ogden and Salt Lake City.	Disaster Declared by president	Snowpack melt. \$621 million.
Flood	April-June 1984	Jordan River, Red Butte Creek.		Snowpack melt.
Lightning	07/08/1984	Little Cottonwood Canyon		1 death.
Waterspout	06/25/1985	Great Salt Lake		
Flood	06/03/1986	Great Salt Lake		Large runoff. 140 year record altitude of 4211.85 feet on June 3, 1986. \$268 million in damage.
Tornado	09/09/1986			F0

Tornado	01/10/1989			F1
Tornado	03/02/1989			F1
Tornado	07/08/1989			F1
Tornado	08/16/1990			F0
Tornado	08/30/1992			F0
Tornado	11/05/1993			F0
Severe Storm	10/05/1994	Salt Lake Valley	Airport, Holladay, Cottonwood Heights, Millcreek.	Over \$330,000 damage
Tornado	05/08/1998			F0
Lightning	07/10/1998	Draper		1 death.
Tornado	09/12/1998			F0
Tornado	08/11/1999	Salt Lake City		F2. 1 death, 80 injured.
Lightning	05/24/2000	Midvale		1 death.
Lightning	07/25/2002	Lone Peak		2 deaths.
Severe Storm	12/25-29/03			Power outages, road closures, Provo Canyon Avalanche
Severe Storm	12/26-27/03	Salt Lake City		Heavy snowfall. Record precipitation of 14.8 inches.



\*On September 3, 1983, thunderstorms produced hail ½" to 1½" in diameter throughout the Salt Lake Valley, destroying gardens, denting cars, and damaging roofs. (Photo courtesy of National Weather Service.)

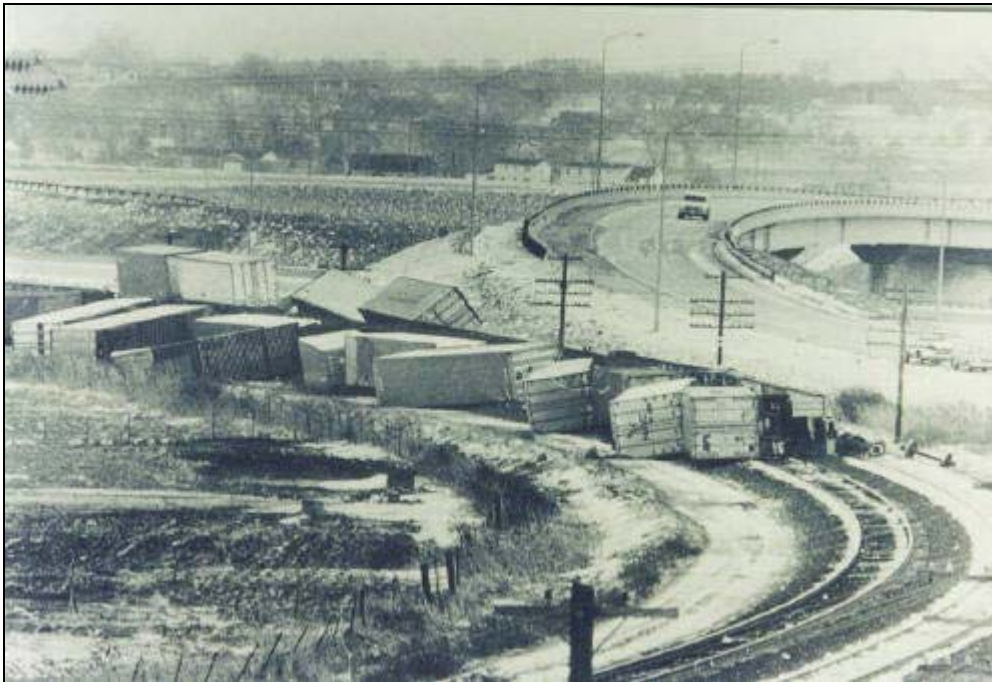


On February 13, 1885, a snow slide at Alta (that was then a mining town) killed 16 people. This photograph was taken on July 3, 1885. (Photo by C.R. Savage.)





On December 23, 1988, a cold front produced heavy snow over the Wasatch Front, with up to five inches reported in some valleys, eight inches along the benches, and two to three feet in the mountains. Several avalanches occurred up Little Cottonwood Canyon. This bus was caught in a snow slide at White Pine in Little Cottonwood Canyon. (Photos courtesy of the National Weather Service.)



On April 4-6, 1983, strong canyon winds created havoc along the Wasatch Front. Wind speeds gusted over 70 mph in many locations, and Hill Air Force Base recorded a gust to 104 mph. Hundreds of trees were uprooted, numerous windows were blown out, and several semi trucks were blown over. The train in this

picture was derailed near Lagoon. Total damage from the winds was estimated at eight million dollars. (Photo by Ogden Standard Examiner.)



Great Salt Lake Waterspout, June 26, 1985. Photo courtesy of National Weather Service.



Great Salt Lake Waterspout, September 12, 1998. Photo courtesy of KTVX News 4 Utah.



Salt Lake City Tornado, August 11, 1999. Photo courtesy of KTVX News 4 Utah.



Salt Lake City Tornado, August 11, 1999. (Orange fireball is a power sub-station exploding.) Photo courtesy of KTVX News 4 Utah.



\*Lightning over Lewis Peak, North Ogden, Utah, August 8th 2003, photo by Gene Poncelet.

## G. Mitigation Goals, Objectives, and Actions

<p style="text-align: center;"><b>Salt Lake County</b> Pre Disaster Mitigation FY2003 (PDM03) Workbook</p>
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County: Salt Lake County  
Address: 3380 S. 900 W.  
City: Salt Lake City, UT  
Zip Code: 84119

Point of Contact: Dennis Stanley  
Email: [dstanley@co.slc.ut.us](mailto:dstanley@co.slc.ut.us)

Signature: \_\_\_\_\_  
Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group

Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

Members of the County/Tribal PDM Working Group:

Name: Russ Scholz	Title: Emergency Coordinator SLC A.R.E.S., Inc.
Name: David Chisholm	Title: Citizen Committee, Holladay
Name: Stephen Higgs	Title: Fire Chief, Midvale
Name: Randy Willden	Title: Battalion Chief, Murray
Name: Dennis Stanley	Title: Bureau Chief, SLCO Fire Emergency Services
Name: Kathy Cuff-Case	Title: Planner, SLCO Fire Emergency Services
Name: Bob Halloran	Title: Deputy Bureau Chief, Emergency Services
Name: Kent R. Miner	Title: SL Valley Health Department
Name: Chris Evans	Title: Battalion Chief, South Jordan
Name: Dawn Black	Title: Asst. Emergency Mgr., Salt Lake City
Name: Nancy Sanchez	Title: Salt Lake Community College
Name: Nancy Barr	Title: Utah DES

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s)

Date: December 3, 2003  
Time: 1:30 p.m.  
Place: Salt Lake County Emergency Operations Center

**Purpose of Meeting:**

To identify mitigation strategies already in place and to identify needed mitigation strategies.

**List of Attendees:**

LaNiece Dustman	Jim Boes
Russ Scholz	David Chisholm
Stephen Higgs	Randy Willden
Dennis Stanley	Kathy Cuff-Case
Bob Halloran	Kent R. Miner
Chris Evans	Dawn Black
Nancy Barr	Nancy Sanchez

**Summary of Meeting:**

LaNiece Dustman from Wasatch Front Regional Council led the group in the discussion. Jim Boes provided current maps. Possible natural disasters were listed and mitigation projects were identified.

**Outcome(s) of Meeting:**

To provide mitigation actions for the pre-disaster mitigation plan and ready each community for a hazard event. Note: countywide refers to mitigation measures which address a hazards in each of the following cities within the county; Alta, Bluffdale, Draper, Herriman, Holladay, Cottonwood, Midvale, Murray, Riverton, Salt Lake City, Sandy, South Jordan, South Salt Lake, Taylorsville, West Jordan, and West Valley.

\*The term “countywide” in this document refers to mitigation strategies benefiting the following communities; Town of Alta, Bluffdale City, city of Draper, Herriman, Holladay-Cottonwood City, Midvale City, Murray City, Riverton City, Salt Lake City, Sandy City, city of South Jordan, city of South Salt Lake, city of Taylorsville, West Jordan City, and West Valley City.

**Hazard: Dam Failure****Problem Identification:**

National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means.

**Goal #1**

Include dam failure inundation in future County planning efforts.

**Objective 1.1: Priority MEDIUM**

Review current State Dam Safety information on all identified high hazard dams in the County

**Action:**

Include dam inundation maps in current County and City EOPs.

Time Frame: 3-5 Years

Funding: Undetermined

Estimated Cost: \$ 10,000.00

Staff: Emergency Services Bureau

Jurisdictions: Countywide

Background: Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section is currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Salt Lake County in future emergency management planning.

**Hazard: Drought****Problem Identification:**

Salt Lake County is currently in the fifth year of drought conditions. Measures must be taken to conserve and address water shortages for both culinary and agricultural use.

**Goal 1**

Reduce hardships associated with water shortages.

**Objective 1.1: Priority HIGH**

Limit unnecessary consumption of water throughout the County

**Action:**

Continue to encourage water conservation utilizing and promoting Jordan Valley Water Conservation outreach material with each City in the County.

Time Frame: Ongoing

Funding: Minimal

Estimated Cost: Undetermined

Staff: Should coordinate with local water districts.

Jurisdictions: Countywide

Background: County as well as the State are experiencing severe drought conditions. Increasing water demand will result in water shortages at some point in non-drought years.

**Objective 1.2: Priority MEDIUM**

Address agricultural water shortages in the County

**Action:**

In areas of agricultural use livestock water rotation has been setup (Herriman, Riverton, Draper and South Jordan, West Valley City and other areas in the Unincorporated County).

Time frame: Ongoing

Funding: Minimal

Estimated Cost: Undetermined

Staff: Emergency Services, USDA Farm Services Agency, And State Agriculture

Jurisdictions: County agricultural communities Herriman, Riverton, Draper, West Valley, and South Jordan

Background: While agricultural areas are limited in County, there still remain concerns for economic hardship for livestock and crop farmers.

**Objective 1.3: Priority Medium**

Encourage the development of secondary water systems

**Action:**

Coordinate with current water systems and develop and secondary waters systems plan for drought

Time frame: Immediate

Funding: Undetermined local sources

Estimated Cost: Minimal

Staff: Water Districts

Jurisdictions: Countywide

Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

**Problem Identification:**

Severe drought continues to maximize the potential for urban wildland interface fires in areas of the Cottonwood Canyons, Emigration Canyon, Rose Canyon, and Neff's Canyon (Unincorporated County) and Traverse/South Mountain and Bear Mountain (Draper City)

**Goal 2 Priority High**

Reduce the amount of fuels that can impact residential homes in urban wild land interface areas.

**Objective 2.1: Priority HIGH**

Study the areas and determine which fire resistant natural vegetation can be used in these areas of concern.

**Action:**

Develop outreach document specific to fire resistant natural vegetation.

Time Frame: Ongoing

Funding: State/County

Estimated Cost: \$5000.00

Staff: County, US Forest Service, Dept. of Agriculture, Utah Living With Fire Committee

Jurisdictions: Targeting URWIN communities adjacent to Forest Service boundary.

Background: Residential property owners need to be educated on the most fire resistant forms of vegetation that can be placed around homes to reduce the threat from wildfire.

**Hazard: Earthquake****Problem Identification:**

Numerous geologic hazards exist in the Salt Lake City metropolitan area, which can constrain land use. Active fault zones pose the threat of earthquakes, while steep mountains adjacent to the city create a potential for landslides, debris flows, rock falls, and snow avalanches. Streams and the fluctuating level of the Great Salt Lake create serious flood and ground-water problems. Considered as a whole, geologic hazards in the Salt Lake City metropolitan area confront planners with a variety of safety and economic issues that must be addressed before wise development can take place. Limited communication or lack of communication capabilities is always a shortfall during an emergency.

**Goal 1**

Increase and harden emergency and non-emergency communication systems

**Objective 1.1: Priority HIGH**

Provide redundancies in countywide communication systems.

**Action:**

Assess current countywide communications and interoperable emergency/warning systems

Time Frame: 1-2 years

Funding: Federal Grants

Estimated Cost: \$ 3,000,000.00

Staff: Emergency Services

Jurisdictions: Countywide

Background: Current countywide communications systems need to be reevaluated.

**Objective 1.2: Priority HIGH**

Ensure adequate coordination of disaster response and recovery activities.

**Action:**

Assess EOC's (countywide)

Time frame: 2-3 years

Funding: Federal Grants

Estimated Cost: \$ 3,000,000.00

Staff: Emergency Services

Jurisdictions: Countywide

Background: It is essential to have functional EOC to better coordinate disaster response and recovery activities

**Goal 2**

Countywide earthquake loss reduction and safety education.

**Objective 2.1: Priority MEDIUM**

Provide information on earthquake potential effects to homeowners and developers.

**Action:**

Update current earthquake maps (liquefaction and fault) and incorporated into the County GIS system.

Time Frame: Ongoing

Funding: Unknown

Estimated Cost: Unknown

Staff: Emergency Services, County GIS, County Geologist, and UGS

Jurisdictions: Countywide

Background: Current earthquake data specific to the County needs to be centralized and easily accessible.

**Objective 2.2: Priority HIGH**

Improve public education regarding earthquake risks to improve quality of construction.

**Action:**

Ensure current natural hazard ordinance(s) are online, linked to Emergency Services website, and easily accessible and can be download.

Time Frame: Ongoing

Funding: Unknown

Estimated Cost: Unknown

Staff: Emergency Services, County Planning and Zoning, Permitting

Jurisdictions: Countywide

Background: Knowledge of construction requirements in high hazard areas prior to the permit process.

**Hazard: Flooding**

**Problem Identification:**

Although located in a semi-arid region, Salt Lake City is subject to cloudburst and snowmelt floods. The Jordan River's three main northern tributaries are diverted into storm sewers beneath the city. During May and June 1983, a sudden warming trend rapidly melted a record mountain snow pack. The resulting runoff quickly exceeded the capacities of the storm sewers, and floodwaters were then diverted onto city streets. The flooding in 1983, and to a lesser extent in 1984, caused flood-control agencies to build sediment basins, install stream-bank protection, and dredge stream channels to reduce flood hazards. The Federal Emergency Management Agency (FEMA) has rated flood plains along the Jordan River and its tributaries for expected flood heights and areas susceptible to 100-year flood-frequency inundation have been delineated on County-wide FEMA Flood Insurance Rate Maps (FIRMs). These maps are updated as development occurs and channel obstructions, culvert modifications, and other changes alter potential flood heights and velocities. Salt lake County ordinances require the lowest flood grades (including basements) in new construction to be a minimum of 1 foot (0.3 m) above the appropriate FEMA flood elevation.

**Goal 1**

Protection of life and property before, during, and after a flooding event.

**Objective 1.1: Priority MEDIUM**

Encourage 100% participation in the National Flood Insurance Program

**Action:**

Assist Holladay City and the Town of Alta to apply for participation in NFIP (National Flood Insurance Program).

Time Frame: 1 year

Funding: None required

Estimated Cost: None

Staff: City Manager, County Emergency Services, And State Floodplain Manager  
Jurisdictions: Alta and Holladay  
Background: Flood insurance is not available in these communities limiting disaster assistance and participation in future mitigation grants.

**Objective 1.2: Priority MEDIUM**

Provide current FIRMs for emergency planners.

**Action:**

Update & digitize floodplain maps

Time Frame: 2-3 year

Funding: County Public Works/Flood Control, State Floodplain Office, and FEMA

Estimated Cost: Unknown

Staff: County Flood Control, County GIS, and FEMA

Jurisdictions: Countywide

Background: Countywide digitized flood maps need to be updated in a timely and efficient manner and local emergency planners made aware of how to access and interpret the data.

**Goal 2**

Reduce threat of unstable canals throughout the county.

**Objective 2.1: Priority MEDIUM**

Identify countywide canal systems

**Action:**

Map and assess for structural integrity canal systems in the County

Time Frame: 3-5 years

Funding: Federal grants

Estimated Cost: Unknown

Staff: Public Works Engineering

Jurisdictions: Countywide

Background: Private and Public canals as well as the Salt Lake Aqueduct are used for transportation and dispersion of water as well as flood control.

**Objective 2.2: Priority LOW**

Identify dry dams/reservoirs that may have the potential for failure.

**Action:**

Map and assess all dry dams/reservoirs in the county

Time Frame: 3-5 years

Funding: Federal grants

Estimated Cost: Unknown

Staff: Public Works Engineering, Utah Dam Safety Section.

Jurisdictions: Countywide

Background: A dry dam is used for flood control or temporary irrigation storage

**Hazard: Landslide**

**Problem Identification:**

Slope instability has not been a major problem in the Salt Lake area, but as development moves higher into the foothills and nearby canyons slope stability is becoming a major issue affecting future development. Types of slope instability in the Salt Lake area include rock fall, debris flow and debris flood, rotational and transitional slumps, and earth flows. During unusually wet springs in 1983 and 1984 numerous slope failures in the Wasatch Range resulted in debris flows and floods that caused extensive damage to urban

areas north of Salt Lake City (Anderson and others, 1984). Similar failures occurred in canyons adjacent to Salt Lake City, but none reached developed areas.

In Salt Lake County, 56 percent of all slope failures have occurred on hillsides where slopes range between 31 and 60 percent. That statistic prompted Salt Lake County in 1986 to lower the maximum allowable buildable slope from 40 percent to 30 percent. Even so, 23 percent of observed slope failures have occurred on slopes of 30 percent or less.

### **Goal 1**

Reduce or eliminate the threat of landslide damage.

#### **Objective 1.1: Priority MEDIUM**

Reduce the threat of landslides/debris flow following wild fires.

##### **Action:**

Develop protocol for working with State and Federal agencies in developing impact of post fire debris flow hazard.

Time Frame: Unknown

Funding: Federal Grants

Estimated Cost: Unknown

Staff: Emergency Services, National Weather Service, NRCS, USFS, and UGS

Jurisdictions: County communities on Alluvial Fans.

Background: Post fire debris flows have caused significant damage to communities impacted by wild fire.

#### **Objective 1.2: Priority MEDIUM**

Monitor historical landslide areas.

##### **Action:**

Evaluate current landslide maps to verify accuracy.

Time Frame: Unknown

Funding: Federal Grants

Estimated Cost: Unknown

Jurisdictions: Salt Lake City and Draper

Staff: Emergency Services, County Geologist, UGS, and USGS

Background: Currently available mapping on active landslides within Salt Lake County may not reflect accurately the risk on the ground.

#### **Objective 2.2: Priority MEDIUM**

Improve public awareness regarding high-risk landslide areas.

##### **Action:**

Have landslide maps readily available on line through County EM website

Time Frame: Unknown

Funding: Federal Grants

Estimated Cost: Unknown

Staff: Emergency Services/County Geologist, UGS, and USGS

Jurisdictions: Target identified high-risk communities.

Background: Allows communities, residents, developers, planners and emergency managers access to information

### **Hazard: Severe Weather**

#### **Problem Identification:**

Snowstorms over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists. The region is characterized by intense

vertical relief with the Great Salt Lake and surrounding lowlands located near 4300 ft MSL while the adjoining Wasatch Mountains to the east reach as high as 11,000 ft MSL. This relief has major impact on winter storms and results in large contrasts in average annual snowfall. For example, Salt Lake City International Airport (4280 ft MSL) receives an average annual snowfall of 65" while Alta ski area (8750 ft MSL) observes 520". Populated terrain benches surrounding the Salt Lake, which are located 150-200 m higher than the airport, have annual accumulations near 100".

### **Goal 1**

Reduce the threat of life loss due to severe weather.

#### **Objective 1.1: Priority LOW**

Become NWS Storm Ready Community

##### **Action:**

Contact NWS/SLC Office and begin process of becoming a Storm Ready Community.

Time Frame: Unknown

Funding: None

Estimated Cost: Unknown

Staff: Emergency Services/National Weather Service

Jurisdictions: Countywide

Background: Becoming a Storm Ready Community is a positive public outreach and preparedness effort that involves the entire County.

#### **Objective 1.2: Priority LOW**

Improve response times to severe weather alerts.

##### **Action:**

Incorporate NWS on light boards on freeway system.

Time Frame: Unknown

Funding: Federal Grants

Estimated Cost: Unknown

Staff: Emergency Services/National Weather Service/UDOT

Jurisdictions: Countywide

Background:

#### **Objective 2.1: Priority LOW**

Address Countywide needs of special populations that may be impacted by severe weather conditions.

##### **Action:**

Create outreach materials (what to do when severe weather strikes) specific to this group and insert the information into County-wide phone books, and phone books specific to 55+ age group developed in County Aging services.

Time Frame: Unknown

Funding: Federal Grants

Estimated Cost: Unknown

Staff: Emergency Services/National Weather Service

Jurisdictions: Countywide

Background: Secondary events due to severe weather such as power outages and the shoveling of snow can have a great impact on the elderly population.

##### **Action:**

Encourage avalanche preparedness for county backcountry users.

Time Frame: 1 Year

Funding: Minimal

Estimated Cost: Minimal

Staff: City and county Emergency Managers, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.

Jurisdictions: Countywide

Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual is more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Salt Lake County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in their party. Thus, education can limit the number of avalanche related searches each year.

**Objective 2.2: Priority MEDIUM**

Prevent damage to critical facilities

**Action:**

Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.

Time frame: 2-3 years

Funding: Federal Grants

Estimated Cost: Unknown

Staff: Emergency Services/County Facilities

Jurisdictions: Countywide

Background:

**Hazard: Wildfire**

**Problem Identification:**

Utah's typical fire season is the dry period from May through October. Lightning causes the largest numbers of wildfires. The recent wildfires in the western States, the 1994 Tyee fire in Washington, the 1993 Southern California fire siege, and the 1991 Oakland Hills fires are examples of the growing fire threat which results from the Wildland/Urban Interface. The Wildland/Urban interface is defined as the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Since 1985, approximately 9,000 homes have been lost to urban/wildland interface fires across the United States. In 1990 Salt Lake County created a wildland program shortly after a wildland fire threatened Emigration Canyon, a major urban interface area at the county's eastern boundaries. The fire began in a day use picnic area known as Afleck Park, possibly the result of an unattended campfire. The fire quickly spread to the west and up the side of the mountain, with only one ridge between it and Emigration Canyon. The incident lasted for five days, in which time 5500 acres were burned, but fortunately, no one was injured and no structures were lost.

**Goal 1**

Wildfire community education.

**Objective 1.1: Priority HIGH**

Reduce overall risk from wild fire through education programs.

**Action:**

Public awareness through "Fire Wise" programs.

Time Frame: 2-3 years

Funding: Unknown

Estimated Cost: Unknown

Staff: Fire Departments, Utah Living With Fire, US Forest Service, and UFFSL

Jurisdictions: Countywide

Background: Wildfire education will be part of a holistic natural hazard education program pushed countywide. The program will include training on wildfires,

earthquakes, flooding, landslides, and severe weather. Fire Wise training will include Utah specific wildfire safety material developed by the Utah Living With Fire Committee. Urban Wildland Interface areas will be identified and targeted. County and City fire departments in the past have pushed wildland fire prevention and protection techniques with success. Fire departments have used door hangers discussing defensible space, participated in Emigration Canyon public wildfire awareness exercises, and offered free home fire proofing evaluations.

**Objective 1.2: Priority HIGH**

Educate homeowners on the need to create open space free of burnable fuels near structures in urban wild land areas.

**Action:**

Defensible space

Time frame: Ongoing

Funding: Local

Estimated Cost: \$ 5000.00

Staff: Emergency Services, County and City Fire Departments.

Jurisdictions: Identified URWIN communities

Background: Defensible space is the process of preparing ones home to be easily defended by the fire department in the event a wildfire occurs.

## **H. Maps**

All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan.

Map 9.1.1 Salt Lake County Earthquake Hazard

Map 9.1.2 Salt Lake County Liquefaction Potential

Map 9.2.1 Salt Lake County Wildfire Risk

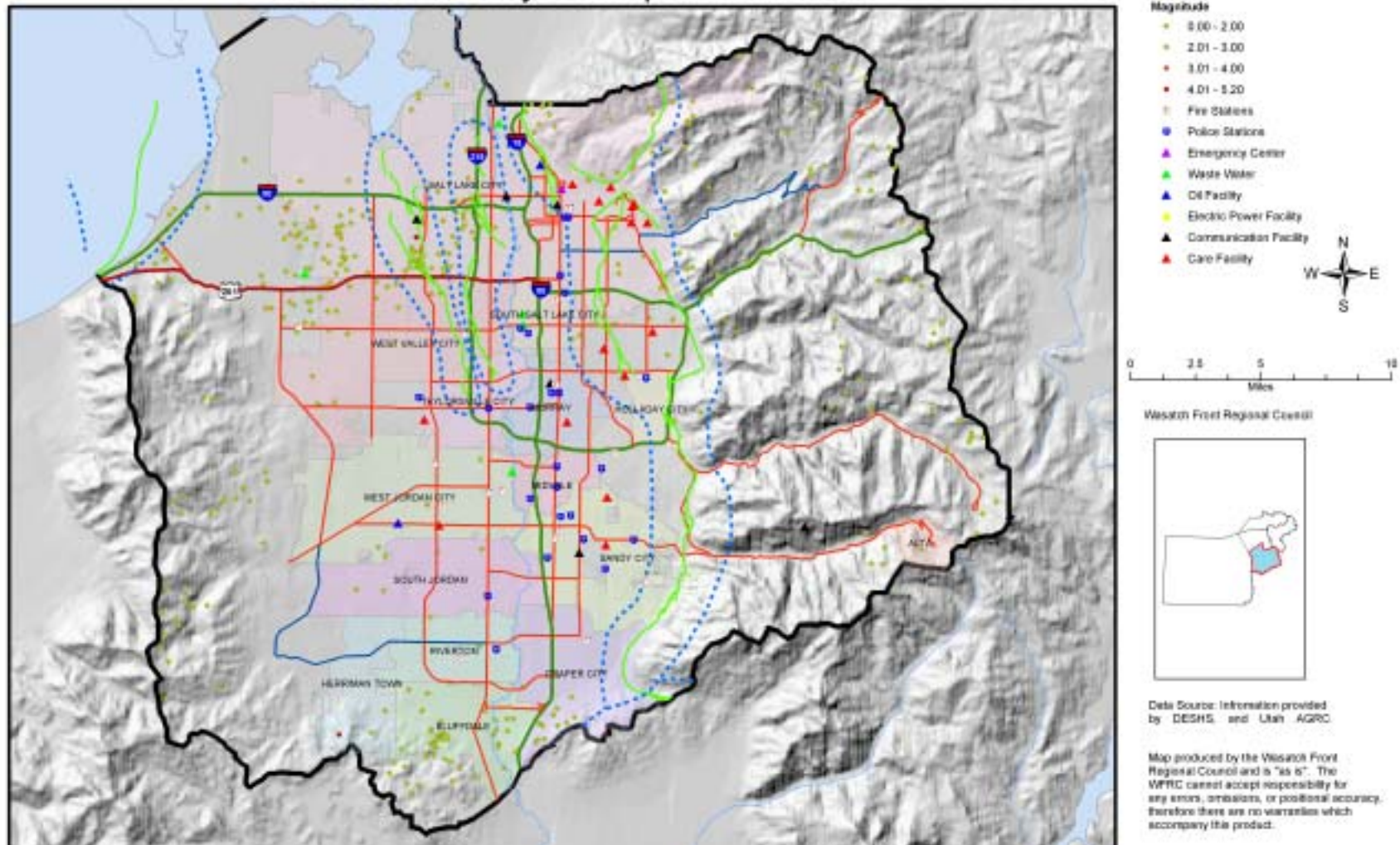
Map 9.3.1 Salt Lake County Flood Hazard

Map 9.4.1 Salt Lake County Dam Hazard

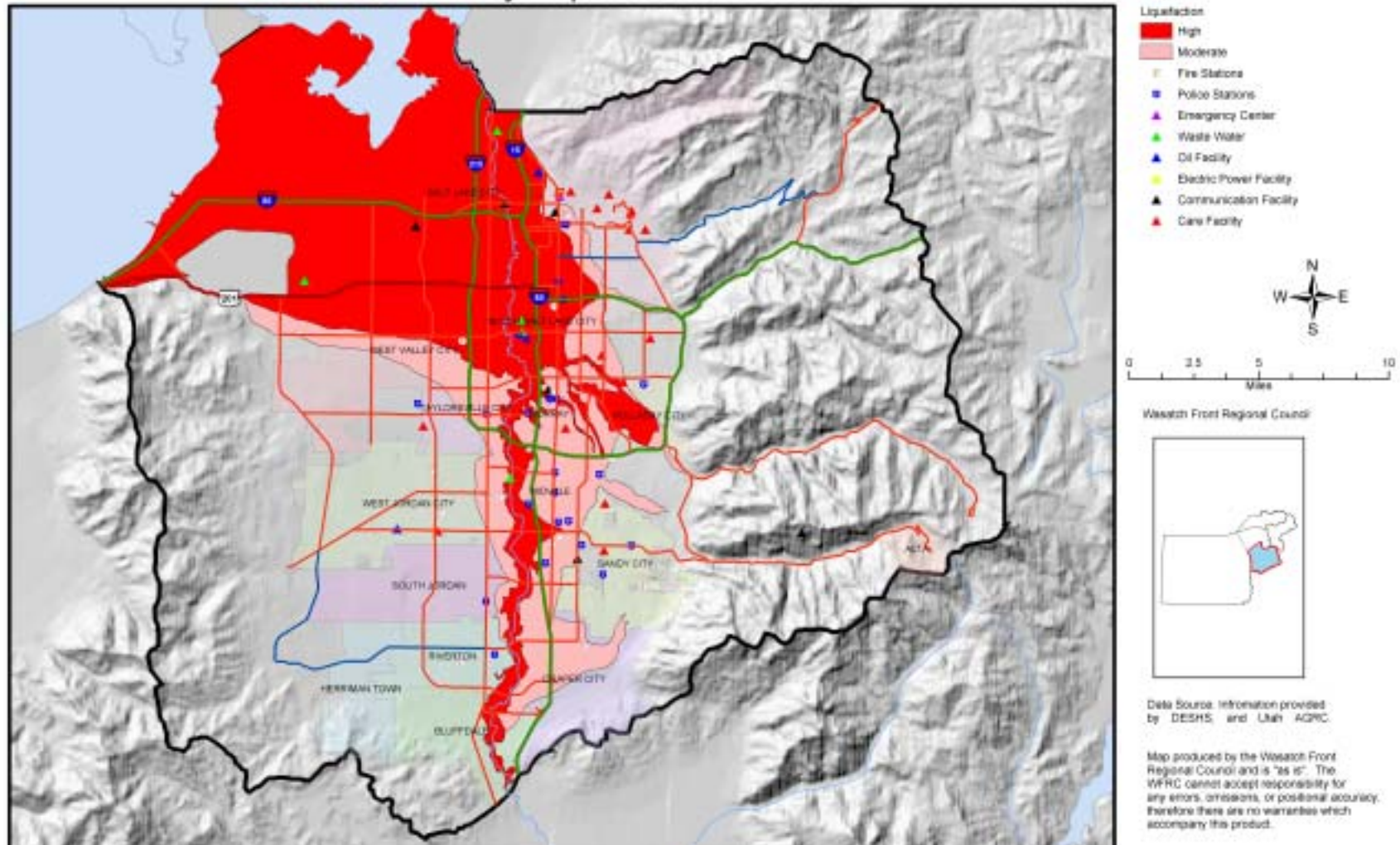
Map 9.4.2 Salt Lake County Dam Failure Hazard

Map 9.5.1 Salt Lake County Landslide Hazard

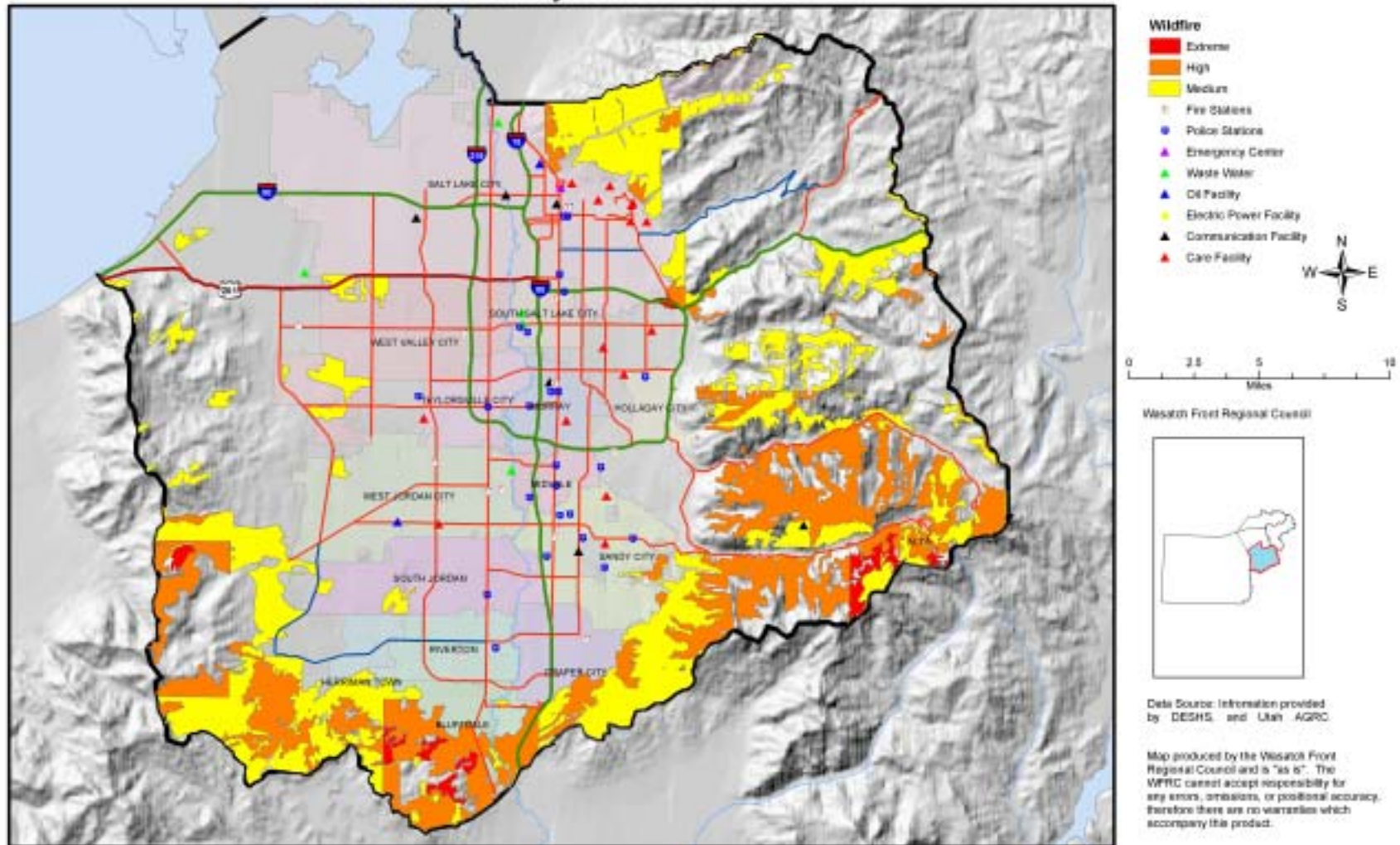
## Salt Lake County Earthquake Hazard



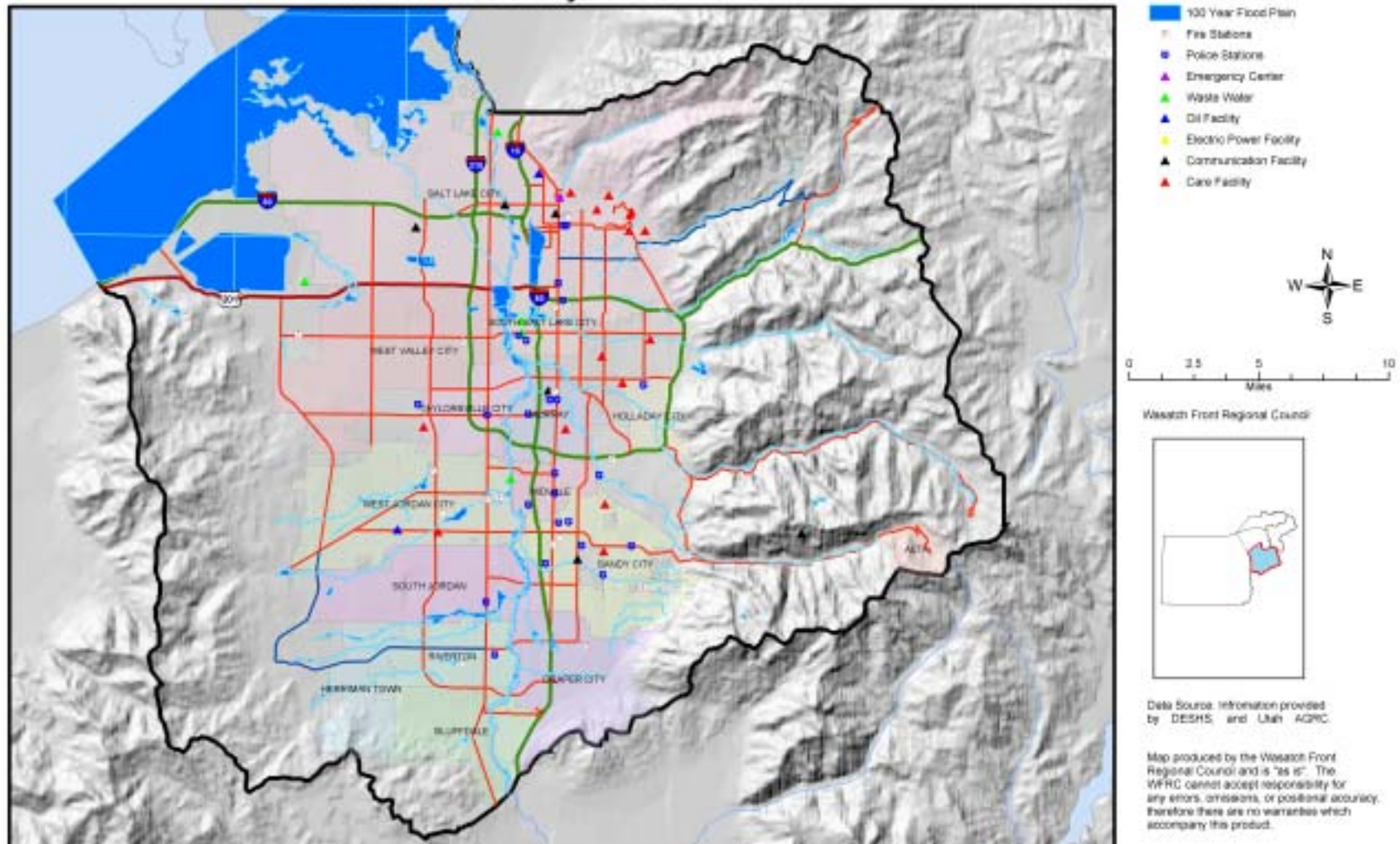
## Salt Lake County Liquefaction Potential



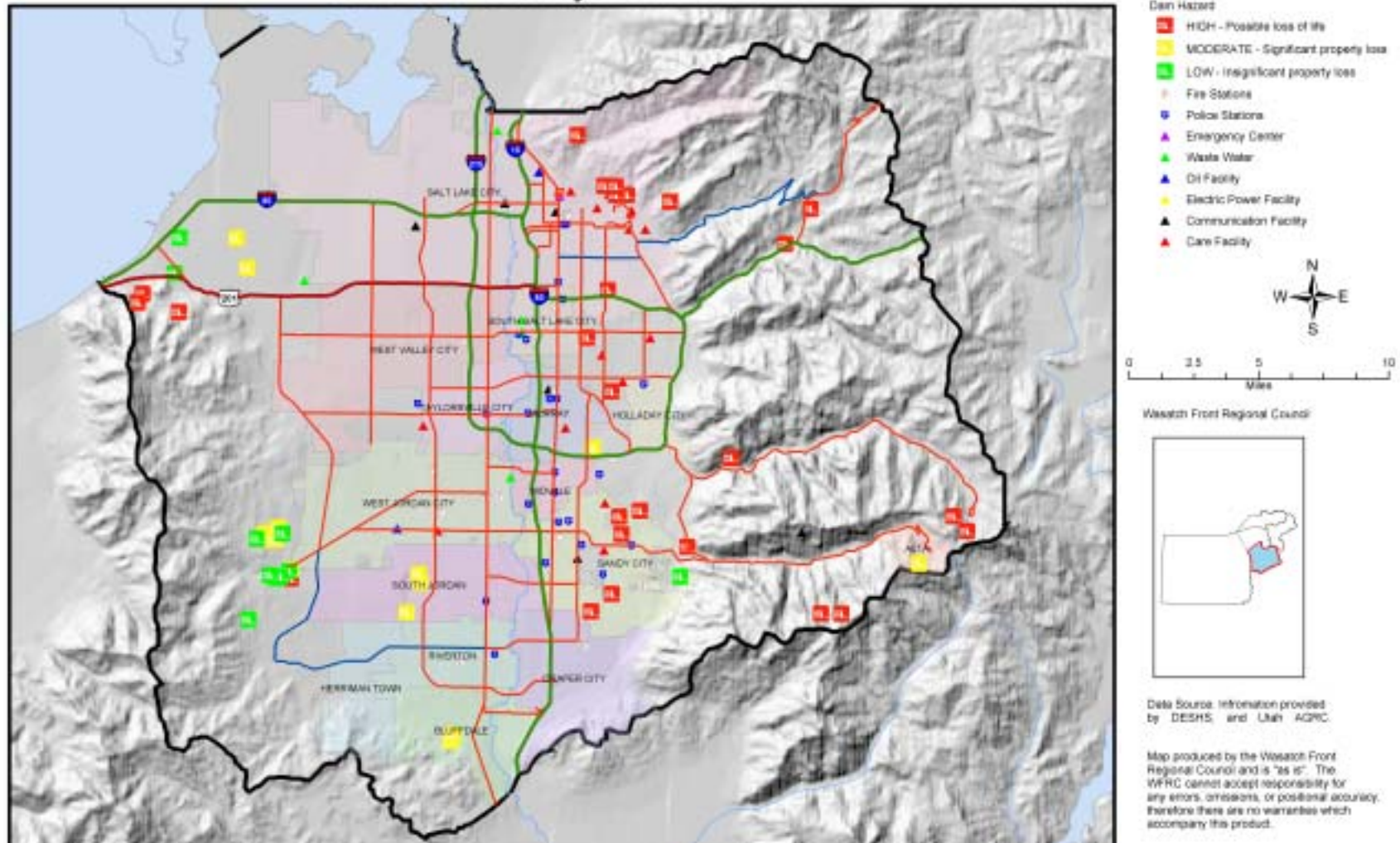
## Salt Lake County Wildfire Hazard



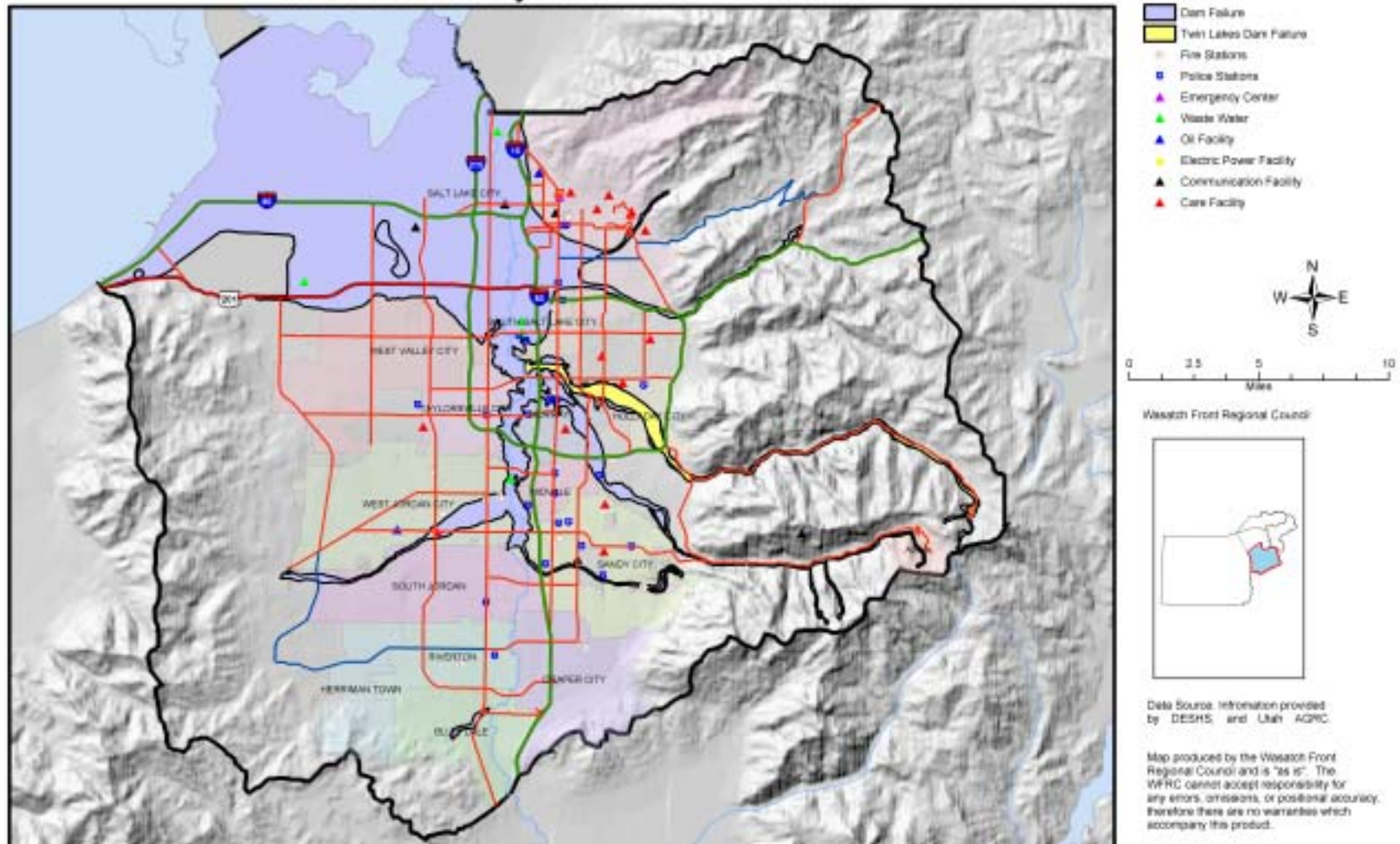
## Salt Lake County Flood Hazard



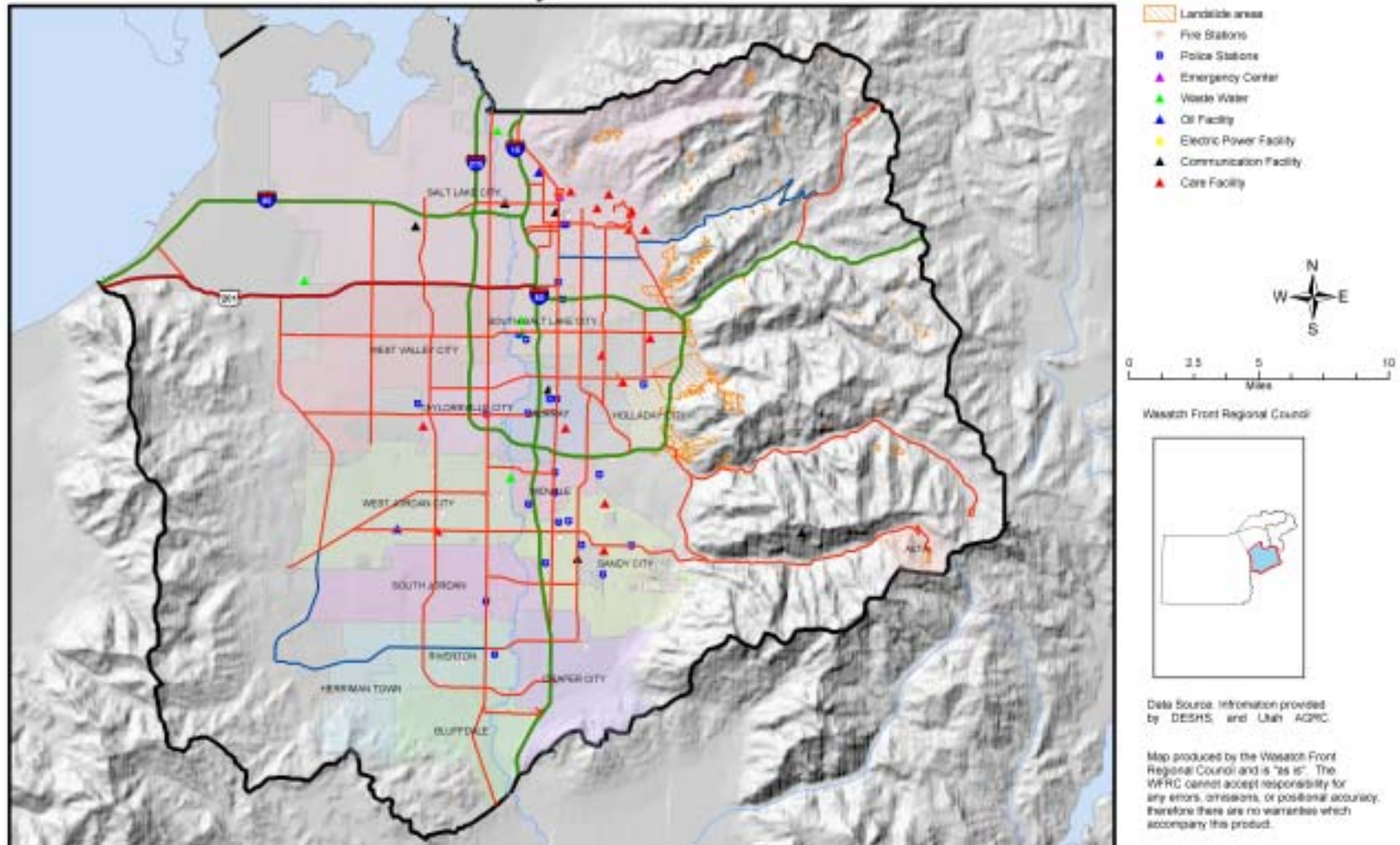
## Salt Lake County Dam Hazard



## Salt Lake County Dam Failure Hazard

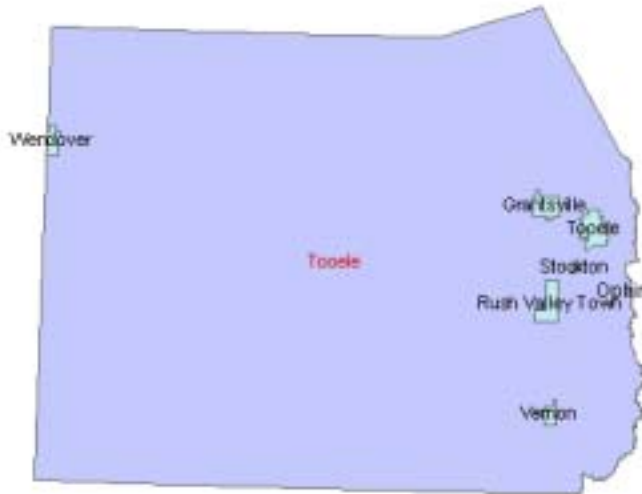


## Salt Lake County Landslide Hazard



## Part X. Tooele County

Tooele County is the second largest county in Utah in terms of land area, with 6,923 square miles. Salt Lake and Utah Counties bound the county to the east, Juab County to the south by, Davis and Box Elder Counties to the north, and to the west the State of Nevada. Three fourths of the population lives in the eastern valleys where most of the irrigated and dry farm land is located. The western sectors make up the Great Salt Lake Desert and are more arid and generally uncultivated. Tooele County includes seven municipalities: Grantsville City, Ophir Town, Rush Valley Town, Stockton Town, Tooele City, Vernon Town, and the city of Wendover.



### A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends are summarized in Table 10-1 below. Understanding population and development trends is important in defining the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community.

**Table 10-1 Population**

Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990-2000	Percent Change 1990- 2000	AARC 1990- 2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Tooele County	26,601	40,735	14,134	53.1%	4.4	8	8	4	4
Population by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Tooele County	26,033	26,601	40,735	50,119	59,780	70,338	79,539	97,055	2.94%

<b>Households by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000- 2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Tooele County	7,966	8,581	12,677	16,057	19,669	23,679	27,505	35,123	3.46%
<b>Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Tooele County	1.78%	1.54%	1.82%	2.03%	2.14%	2.25%	2.36%	2.57%	1.15%
<b>Household Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Tooele County	1.78%	1.60%	1.81%	2.03%	2.15%	2.28%	2.41%	2.66%	1.29%
<b>Average Household Size by County and Multi-County</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Tooele County	3.23	3.07	3.11	3.04	2.97	2.90	2.82	2.70	-0.47%
Source Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget. 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes. Note AARC is average annual rate of change									

## B. Economy

Employment in Tooele County is based on four main types of industry according to the Employment Distribution of 2000; Government and Local Government 30.9% (Federal Defense- Tooele Army Depot and Dugway), Trade 19.4% (restaurants, grocery stores, department stores), Services 17.5% (health care, engineering services, and business services), and Manufacturing 13.3%. Other industries include Construction 5.4%, Fire 2.6%, and Transportation/ Communication/ Utilities 10.9%. Some of the largest employers include Tooele County School District, Dugway Proving Grounds, EG&G Defense Materials, Detroit Diesel, Magnesium Corp of America, Wal-Mart, Tooele County, Tooele Valley Regional Medical Center, Battelle Memorial Institute, and Envirocare of Utah. Top private sector employers include EG&G, Magnesium Corporation of America, Detroit Diesel, Laidlaw Environmental, Wal-Mart, Mortan Salt, Smiths, and Albertson's.

In 2000 the average monthly wage in the county was \$2,508, 4% higher than the state average of \$2,401. This was mainly due to the amount of federal employees. However, recent federal job losses have reduced Tooele County wages closer to the state average. Total personal income in millions in 2000 and 2001 was \$772 and \$840 respectively. The 2001 per capita income was \$18,906 and the average monthly nonfarm wage for 2001 was \$2,585. The unemployment rate in 2000 was 5.3% with the unemployed labor force equaling 642.

Tooele County migration patterns show that most of the 1980's is characterized by out-migration. However, in the 1990's the pattern reversed and beginning in 1996 in-migration from Salt Lake County residents began, mainly for the cheaper housing in the county.

### **C. Transportation and Commuting Patterns**

The major transportation routes within the county include Interstate 80 (I-80), which runs east west and carries the most traffic. The 2000 annual average daily traffic volume for Interstate 80 was 36,170. Another major route is State Route 196 (SR 196) that extends north south close to the central portion of the county. The 2000 annual average daily traffic volume for SR 196 was 305. State Route 36 (SR 36) from Mills Junction also extends north south on the eastern edge of the county and has an average daily traffic volume of 25,820. State Route 138 (SR 138) is the connection route from I-80 to Grantsville and Mills Junction. This route has an average daily volume of 7,305 in 2000. Local County Road 2694 runs north south and connects I-80 to Grantsville and has an average daily traffic volume of 1450 users. State Route 112 (SR 112) beginning from SR 138 into Tooele City had 2000 annual average daily traffic volume of 5,145. State Route 199 (SR 199) had 955 average daily users from SR 36 west of Rush Valley.

### **D. Land Use**

Construction activity in the county has been climbing since the last 1990's and in 1996 exploded. In 2000 and 2001 the housing growth slowed slightly, but still remains highly active. The 2000 numbers for persons per square mile within the county was 5.9, ranked 15<sup>th</sup> in the state. Percent of land ownership is 78.5% Federal, 5.9% State, 0.3% Native American, 11.2% Private and Local Government, 4.1% water.

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. A majority of the county is expected to be developed for residential uses. These local master plans call for relatively low-density development patterns, with some pockets of denser activity. This pattern holds true for non-residential development as well as residential development. Population growth and new commercial development are expected to occur in relatively undeveloped areas of the region. New commercial development is projected in Tooele County to serve the increasing numbers of residences in the county. Tooele County, is projected to more than double its population to 97,055. A significant portion of this increase is expected to commute to Salt Lake County to work. Recent census data shows that approximately 40 percent of Tooele County workers commute to Salt Lake County.

Tooele County has taken measures to help eliminate the risk related to natural hazards including drought, infestation, and severe weather. These measures include giving discounts or credits to those residents who use less water. Infestation has been mitigated through research activities identifying breeding patterns, control methods, and feeding and reproducing patterns. Tooele County is the first and only "Storm Ready Community" in Utah; this allows those participating agencies to always stay on top of severe weather hazards. For more information review Section G for specific mitigation actions.

### **E. Risk Assessment**

The risk assessment process revealed the following for identified hazards of drought, wildland fire, severe weather/ flash flood, earthquake, and infestation. Severe weather and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are 39 critical facilities in Tooele County, refer to Appendix D for a complete list for the entire county.

# 1. Wildland Fire

## Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

## Description of Location and Extent

Potential wildfire hazard within Tooele County is growing as population growth is spreading into wildland areas known as Urban-Wildland Interface Zones. Over the past 20 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property.

According to the County Emergency Operations Plan the following communities and surrounding areas are within the interface zone; Lofgreen, Vernon, Faust, Ophir, Mercur, Deseret Chemical Depot, Rush Valley, Big Hollow Canyon, Terra, Dugway, Skull Valley, Grissamar's Farm, Hogan's Ranch, Stockton, Soldier Canyon, Settlement Canyon, Tooele Army Depot, Pine Canyon, South Willow Canyon, Outer Grantsville City, Erda.

Wildfire maps were created using GIS and can be viewed in Section H Map 10.1.1 Tooele County Wildfire Risk. The map layers were provided by DESHS and show five categories of wildfire risk:

- Extreme
- High
- Medium
- Low
- Very Low

These ratings cover all of Tooele County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment. For an idea of the wildfire history for Tooele County refer to Table 10-5.

## Vulnerability Assessment

The following tables identify the value and number of structures, infrastructure, and critical facilities located in the wildfire areas, population numbers are also included (Tables 10-2, 10-3, 10-4).

**Table 10-2 Structures and Population in Wildfire Area**

City Name	City Area (Acres)	Acres in Extreme	Acres in High	Acres of Moderate	Number of Structures within Wildfire Risk Area		Population In Hazard Areas
					Commercial/ Annual Sales	Residential/ Replacement Value	

Grantsville	10,873	0	5	1362	0 / \$0	24 / \$3,006,432	64
Ophir	37	0	0	13	0 / \$0	2 / \$250,536	0
Rush Valley	11,560	0	91	4,336	0 / \$0	22 / \$2,755,896	46
Stockton	1,085	0	0	503	1 / \$800,000	45 / \$5,637,060	100
Tooele City	13,521	21	1,850	4,806	26 / \$77,900,000	796 / \$99,713,328	2,415
Vernon	5,143	0	0	13966	0 / \$0	3 / \$375,804	7
Wendover	5748	0	0	0	0 / \$0	0 / \$0	0

**Table 10-3 Infrastructure Affected by Wildfire**

Item	Length (Miles)	Replacement Cost
Local Roads	55.21	\$110,420,000
State Highways	67.46	\$162,823,157
US Highways	0.00	\$0
US Interstates	12.66	\$45,582,480
Power Lines	151.58	\$7,318,282
Gas Lines	0.00	\$0

**Table 10-4 Critical Facilities Within Wildfire Area**

Facility Type	Name	City	Wildfire Risk
Communication	KUUU Channel 221	Unincorporated	High
Communication	KTVX Channel 4	Unincorporated	Moderate
Fire Station	North Tooele Co. Fire	Unincorporated	High

**Table 10-5 Wildfire History**

Date	Fire Name	Cause	Size
6/18/84	Skull Valley	Lightning	300 - 999 Acres
7/12/84	Magpie	Lightning	300 - 999 Acres
7/7/85	Faust Fire	Lightning	1000 - 4999 Acres
7/8/85	Lofgreen	Lightning	300 - 999 Acres
7/30/85	Antelope Canyon	Lightning	300 - 999 Acres
8/26/85	Teko Test Range	Lightning	1000 - 4999 Acres
6/27/86	Salt Mtn	Equipment	1000 - 4999 Acres
7/10/86	Circus	Cigarette	1000 - 4999 Acres
7/14/86	Pole	Lightning	1000 - 4999 Acres
7/28/86	Tracy	Equipment	300 - 999 Acres
8/8/86	Cristine	Lightning	1000 - 4999 Acres
8/28/86	Sheep Lane	Lightning	300 - 999 Acres
6/15/87	Ripple Valley	Lightning	> 5000 Acres
6/19/87	BLM Fire # R040	Miscellaneous	300 - 999 Acres
6/24/87	Double Decker	Debris Burn	1000 - 4999 Acres

7/5/87	Torch Turnover	Incendiary	300 - 999 Acres
8/14/87	Coyote	Lightning	300 - 999 Acres
9/12/87	Quincy	Lightning	> 5000 Acres
9/20/87	Post Hollow	Equipment	1000 - 4999 Acres
10/11/87	Winter Springs	Incendiary	300 - 999 Acres
6/14/88	Mud Spring	Miscellaneous	1000 - 4999 Acres
6/16/88	South Davis	Equipment	1000 - 4999 Acres
6/22/88	Davis Complex	Incendiary	> 5000 Acres
7/25/88	South Marble	Lightning	1000 - 4999 Acres
8/14/89	Lakeside	Lightning	1000 - 4999 Acres
8/21/89	Box Elder	Lightning	1000 - 4999 Acres
10/11/89	White Rock	Debris Burn	1000 - 4999 Acres
8/9/90	Big Hollow Complex	Lightning	> 5000 Acres
8/10/91	Cold Spring	Miscellaneous	300 - 999 Acres
8/23/91	West Stansbury	Miscellaneous	300 - 999 Acres
8/25/91	Confusion	Lightning	300 - 999 Acres
6/21/92	Rush Lake	Lightning	300 - 999 Acres
6/21/92	Rush Lake	Lightning	300 - 999 Acres
7/10/93	Table Mountain	Incendiary	300 - 999 Acres
6/7/94	Hatch Well	Miscellaneous	300 - 999 Acres
6/26/94	Choke Cherry	Miscellaneous	1000 - 4999 Acres
7/2/94	Terra	Lightning	1000 - 4999 Acres
7/28/94	Castle Rock	Lightning	1000 - 4999 Acres
8/2/94	Skunk Ridge	Lightning	300 - 999 Acres
8/12/95	South Mountain Fire	Miscellaneous	300 - 999 Acres
6/14/96	Round Top	Incendiary	> 5000 Acres
7/3/96	Gold Hill Fire	Lightning	1000 - 4999 Acres
7/8/96	Davis Knolls	Lightning	> 5000 Acres
7/23/96	Simpson	Incendiary	1000 - 4999 Acres
7/27/96	Aqueduct	Miscellaneous	1000 - 4999 Acres
8/1/96	North Stansbury Complex	Miscellaneous	> 5000 Acres
6/29/97	Railroad #1	Railroad	1000 - 4999 Acres
7/15/97	South Area Fire	Miscellaneous	300 - 999 Acres
8/19/97	Lakeside	Miscellaneous	300 - 999 Acres
9/11/97	Penny's Fire	Lightning	300 - 999 Acres
7/4/98	Simpson Springs	Miscellaneous	1000 - 4999 Acres
7/13/98	Tekoi	Miscellaneous	> 5000 Acres
7/20/98	Topliff	Lightning	> 5000 Acres
6/23/99	Pony Road	Miscellaneous	> 5000 Acres
7/2/99	Rush Fire	Lightning	1000 - 4999 Acres
7/7/99	Clover	Lightning	300 - 999 Acres
7/11/99	Hwy 36	Equipment	1000 - 4999 Acres
8/28/99	Marble Head	Lightning	300 - 999 Acres
8/28/99	Flat	Lightning	1000 - 4999 Acres
8/31/99	Parker Fire	Incendiary	300 - 999 Acres
11/5/99	Salt Mountain	Debris Burn	300 - 999 Acres

6/10/00	Brown Springs	Miscellaneous	1000 - 4999 Acres
6/18/00	Bullion	Lightning	1000 - 4999 Acres
7/5/00	Barrow Pit	Railroad	1000 - 4999 Acres
7/10/00	Cedar Mountain	Lightning	300 - 999 Acres
7/26/00	Cattle Rock	Lightning	> 5000 Acres
8/1/00	Box Canyon	Lightning	300 - 999 Acres
8/12/00	Dry Fork II	Lightning	1000 - 4999 Acres
6/9/01	Eight Mile	Lightning	1000 - 4999 Acres
7/4/01	Harrison	Lightning	300 - 999 Acres
7/14/01	Monarch	Lightning	300 - 999 Acres
8/3/01	Magcorp	Lightning	1000 - 4999 Acres

## 2. Earthquake

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	The Intermountain Seismic Belt, Wasatch and Magna Fault Zones, along with the Oquirrh Marginal and Six Mile Creek Fault Zones. Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

### Description of Location and Extent

In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years. The Salt Lake Segment of the Wasatch Fault Zone underlies the Salt Lake valley. The combined average repeat time for large earthquakes on any of the five central segments (Brigham City, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years. The average repeat time on any single segment ranges from about 1200-2600 years. The last earthquakes on the five central segment range from 620-2120 years ago. On the Salt Lake City segment the probability may be as high as 57 percent in 100 years. A large earthquake on any of the five segments has the potential to affect Tooele County.

Within Tooele County 13 fault zones have been identified. The Topliff Hill Fault Zone is located along the west side of the East Tintic Mountains near southern Rush Valley. The most recent geologic Paleoevent was Late Quaternary faulting. Another fault in the county is the Cedar Mountains Faults (East Side). These are short north-trending normal faults along the east side of Cedar Mountains, Quaternary age faulting. The Skull Valley Faults (Mid-Valley) are located in northern and southern Skull Valley; most recent paleoevent was during the Latest Quaternary (later than the Provo Shoreline). The Stansbury Fault Zone is along the western side of the Stansbury Mountains. The most recent Paleoevent was Latest Quaternary. Saint John Station Fault Zone is also a poorly understood zone of Late Quaternary faulting near Saint John Station in southern Rush Valley. The Oquirrh Fault Zone is a Holocene range-front normal fault along the western base of the Oquirrh Mountains. Southern Oquirrh Mountains Fault Zone is a Late Quaternary normal fault bounding the west flank of the southern Oquirrh Mountains. The Deep Creek Faults are poorly understood faults near the northern end of the Deep Creek Range at the Utah-Nevada border, believed to be Quaternary. Deep Creek Range Fault Zone (Northwest Side) is late Quaternary faulting on the northwest side of the Deep Creek Mountains. The Lookout Pass Fault is a poorly understood Quaternary fault on the south side of Lookout Pass. Sheeprock Fault Zone is also a poorly understood zone of late Quaternary faulting along the eastern side of the Sheeprock Mountains and Red Pine Mountain. Vernon Hills Fault Zone is of Late Quaternary faulting on the east side of the Vernon Hills. The Puddle Valley Fault Zone includes three short faults in Quaternary basin-fill deposits east of the Grassy Mountains in northwestern Utah.

Using latitude and longitude, earthquake ground motion can be looked up on the USGS website for each city within Tooele County. This table identifies ground motion hazard values, Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These will be expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years (Table 10-6).

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but of course is only approximate due to building design and demand. The probability of exceedence is based on some average probability per year, all probabilities are added, a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain time in years. The values listed are for the nearest grid point in decimal degrees 39.70000 Lat and -66.39999 Long.

For a more detailed explanation of values used and metadata refer to the [USGS Earthquake Hazards Program](#) website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage. The cities of Stockton, Ophir, and Rush Valley coordinate systems were unable to be identified for earthquake probabilistic hazard values.

**Table 10-6 Earthquake Probabilistic Hazard- Ground Motion Values**

	<b>10% PE in 50 Year</b>	<b>5% PE in 50 Year</b>	<b>2% PE in 50 Year</b>
<b>Wendover 40:44:08 114:02:09</b>			
PGA	0.5000000	0.5000000	0.5000000
0.2 sec SA	0.5000000	0.6722878	1.288123
0.3 sec SA	0.5000000	0.6338887	1.265440
1.0 sec SA	0.2500000	0.2552070	0.6580135
<b>Grantsville 40:35:49 112:28:03</b>			
PGA	0.5000000	0.7227937	1.286365
0.2 sec SA	1.150691	1.918589	3.374138
0.3 sec SA	1.079845	1.796840	3.309244
1.0 sec SA	0.4727494	0.8908601	1.830477
<b>Tooele City 40:32:11 112:18:05</b>			
PGA	0.5000000	0.7227937	1.286365
0.2 sec SA	1.150691	1.918589	3.374138
0.3 sec SA	1.079845	1.796840	3.309244
1.0 sec SA	0.4727494	0.8908601	1.830477
<b>Vernon 40:05:29 112:26:59</b>			
PGA	0.5000000	0.7227937	1.286365
0.2 sec SA	1.150691	1.918589	3.374138
0.3 sec SA	1.079845	1.796840	3.309244
1.0 sec SA	0.4727494	0.8908601	1.830477

### Vulnerability Assessment

The potential losses attributed to the earthquake hazard are identified in the tables below, including the type and number of residential, commercial, and critical facilities located in the earthquake hazard area (Tables 10-7, 10-8, 10-9).

**Table 10-7 Structures and Population in Earthquake Fault Zone**

City Name	City Area (Acres)	Acres in Earthquake Fault Zone	Number of Structures within Earthquake Fault Zone		Population in Hazard Areas
			Commercial/ Annual Sales	Residential/ Replacement Value	
Grantsville	10,873	0	0	0	0
Ophir	37	3	0	0	0
Rush Valley	11,560	783	0	8 / \$1,002,144	23
Stockton	1,085	0	0	0	0
Tooele City	13,521	284	0	98 / \$12,276,264	314
Vernon	5,143	0	0	0	0
Wendover	5748	0	0	0	0

**Table 10-8 Infrastructure in Earthquake Area**

Item	Length (Miles)	Replacement Cost
Local Roads	22.80	\$45,600,000
State Highways	58.92	\$142,205,592
US Highways	0.00	\$0
US Interstates	8.12	\$29,246,760
Power Lines	109.69	\$5,295,833
Gas Lines	0.00	\$0

**Table 10-9 Critical Facilities in Earthquake Area**

Name	City
Waste Water Facility	Unincorporated
Lake Point Improvement District	Lake Point

### HAZUS MH Vulnerability Assessment

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 10-10 identifies the probable casualties during an earthquake.

**Table 10-10 Casualties**

Casualties	Nighttime –Minor	241
	Nighttime –Major	6
	Nighttime -Fatalities	11
	Daytime –Minor	278
	Daytime –Major	10
	Daytime- Fatalities	19
	Commute –Minor	239
	Commute –Major	8
	Commute-Fatalities	15

#### **Building Damage by Count**

Building damage is classified by HAZUS MH in five damage states: none, slight, moderate, extensive and complete. Table10-11 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage. Table 10-12 identifies the critical facilities affected by earthquake.

**Table 10-11 Building Damage by Count with Moderate to Complete Damage**

Category	Number of Structures
Residential	1,151
Commercial	42
Industrial	9
Totals	5,216*

\*Includes all building categories with moderate to complete damage

**Table 10-12 Critical facilities**

<b>Classification</b>	<b>Total</b>	<b>Least Moderate Damage &gt;50%</b>	<b>Complete Damage &gt; 50%</b>	<b>Functionality &gt; 50% at day 1</b>
<b>Hospitals</b>	1	1	0	0
<b>Schools</b>	22	0	0	7
<b>EOCs</b>	0	0	0	0
<b>Police Stations</b>	6	0	0	0
<b>Fire Stations</b>	5	0	0	1

### **Debris Removal**

Table 10-13 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

**Table 10-13 Debris Generated (thousands of tons)/Loads to Remove Debris**

Debris Generated	187
Loads (25 tons per load)	7,480

### **Fire Following**

The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS MH uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 10-14 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

**Table 10-14 Fire Following Event, Population Exposed, and Building Stock Exposed**

Ignitions	3
People Displaced	68
Value Exposed (mill. \$)	3

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

### 3. Infestation

#### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Agricultural lands, Forested areas, areas of extreme drought, countywide		
Seasonal Pattern or Conditions	Summer months, related to drought		
Duration	Months to years		
Analysis Used	Reviewed information provided by UGS, DESHS, AGRC, Idaho’s Forest Health Protections agency, Utah Forestry Fire and State Lands, Utah Forest Service, Utah State University Extension Service, and local input.		

#### Description of Location and Extent

Tooele County has experienced several destructive insect infestations in the past mainly from grasshoppers, crickets and other insects. In 1999 Tooele County along with several other counties, declared an insect emergency due to the grasshopper inundation that was one of the most severe in recent history. In the small community of Ibapah there were as many as 177 grasshoppers per square yard, a count of eight per square yard is considered an infestation. The county requested funding to help fight the grasshoppers that were causing severe damage to farmland, and even suburban lands. In 1999 grasshoppers infested 30,000 acres and Mormon crickets infested 490,000 acres. A total of 7,262 acres were treated to fight the infestation.

The forests of Tooele County have been infested with numerous destructive insect species that are described further in the paragraph below. Surveyors from Boise, Idaho's Forest Health Protection conducted a study based on infestation in Utah's forests. With help from the Forest Health Coordinator from Utah Forestry Fire and State Lands (FFSL) the following information was made available. No other known county data was available.

In 1998 no surveys were conducted. In 1999 3% of the counties' total acres were surveyed, the Douglas Fir Beetle affected 999 trees or 497 acres and the Spruce Beetle affected 30 acres. The Fall Cranker worm affected 207 acres, and the Aspen Defoliation struck 55 acres. In 2000, 2001, and 2002 no surveys were conducted.

Because of the amount of forested lands within the county the risk potential of infestation is countywide. The probability of a future event is closely related to the probability of drought. Therefore if the county continues to remain in a drought cycle, infestation will also be a problem. Infestation affects agricultural lands, and therefore, the local economy suffers from related impacts. Infestation once in place can last from several months to years.

#### Vulnerability Analysis

Due to the lack of digitized data and geographic extent of infestation potential loss estimates and a complete vulnerability analysis was unable to be completed. However, current monitoring of the infestation species is providing information on mitigation actions to pursue in a future event. Monitoring has also provided a better understanding of what has been affected in the past.

## F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Included in Table 10-15 Hazard Histories are hazard events with as much relevant information as was available including date, location, area impacted, and damage costs. Problem soil, and severe weather events including infestation, avalanche, lightning, and high winds are not included in the table. Due to the geographic extent and nature of these hazards past events have not been recorded.

**Table 10-15 Hazard Histories**

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Avalanche	1876	Ophir Canyon		1 death, property damages.
Flood	07/23/1878	Skull Valley	Johnson's Settlements	2 deaths and loss of cattle
Avalanche	1926	Ophir Canyon		Property damage
Avalanche	1939	Ophir Canyon		3 deaths
Flood	06/04/1945	Tooele City		Streets flooded
Drought	1953-1965	Regional		
Flash Flood	08/23/1955	Grantsville		Flooding along Durfee Street
Flood	08/25/1961	Gold Hill		Deep Creek and Bar Creek. Dam destroyed worth \$10,000.
Flood	06/03/1963	Wendover	US 40-50 flooded	Property damage.
Flood	06/17/1963	Tooele		Roads (Main and Vine) and residents flooded.
Tornado	06/01/1965			F1
Tornado	06/25/1965			
Tornado	08/09/1965			F1
Flood	06/10/1967	Tooele		Roads and homes flooded.
Tornado	05/22/1968	Dugway Proving Grounds		F1
Flood	08/10/1968	Tooele		Residential and commercial property flooded. Worst in 50 years.
Flood	05/17/1973	Ophir	Ophir Creek	Residential and culinary water system damage.
Drought	1974-1978	Regional		
Mudslide/ Slope Failure	05/14/1984	Middle Fork Canyon	Carr Fork Mine	1 death
Waterspout	06/25/1985		Great Salt Lake	
Waterspout	09/10/1986		Great Salt Lake	
Tornado	07/25/1991	Erda		F1. Property damage.
Tornado	05/03/1993	Erda		F1. \$50000 in damage.
Lightning	08/23/2000	North End Stansbury Mtns.		2 deaths

## G. Mitigation Goals, Objectives, and Actions



### Tooele County Pre Disaster Mitigation FY2003 (PDM03) Workbook

County: Tooele  
Address: 47 S Main Street  
City: Tooele  
Zip Code: 84074

Point of Contact: John Michaelson  
Phone: 435-843-3267

Signature: \_\_\_\_\_

County/Tribal Emergency Management Director

Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group. Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

#### Members of the County/Tribal PDM Working Group:

Name: Kari Sagers  
Name: John Michaelson  
Name: Raymond Johnson  
Name: Dana Truman  
Name: Matt Palmer  
Name: Nicole Cline  
Name: \_\_\_\_\_  
Name: \_\_\_\_\_

Title: Director T.C.E.M.  
Title: Hazard Analyst  
Title: Tooele County Engineer  
Title: \_\_\_\_\_  
Title: Tooele County  
Title: Tooele County Planner  
Title: \_\_\_\_\_  
Title: \_\_\_\_\_

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s). Include additional sheets of information as needed.

Date: November 13, 2003  
Time: 09:30  
Place: Tooele County Emergency Management Office

**Purpose of Meeting:**

Discuss mitigation strategies for natural hazards in Tooele County

**List of Attendees:**

Kari Sagers  
John Michaelson  
Dana Truman  
LaNiece Dustman  
Jim Boes  
Matt Palmer  
Nicole Cline

**Summary of Meeting:**

The group completed the drought hazard identification and it was decided that we would split up the rest of the tasks to the people who knew those hazards best. It was also decided that we could accomplish the entire task by e-mail and phone conversations.

**Outcome of Meeting:**

Created a working group and mitigation workbook for future hazards.

\*The term "countywide" shall include the following jurisdictions: Grantsville City, Ophir Town, Rush Valley Town, Stockton Town, Tooele City, Vernon Town, and the City of Wendover.

**Hazard: Drought**

**Problem Identification:**

Large areas that lack sufficient precipitation to maintain ground water levels within the County, affecting culinary, agricultural and commercial/industrial uses.

**Objective 1: Priority HIGH**

Take actions to maintain adequate culinary water supplies

**Action:**

Develop a public awareness campaign to encourage water conservation.

Time Frame: Ongoing

Funding: Apply for available local, state, and federal grants

Estimated Cost: TBD

Staff: County USU Extension, Health Department, Emergency Management and auxiliary personnel.

Background: Multi-agency coordination effort

**Action:**

Establish economic incentives for water conservation.

Time Frame: Ongoing

Funding: Grants available through state government

Estimated Cost: TBD

Staff: City Officials, Local water systems

Background: Awareness to city and local officials

**Objective 2: Priority MEDIUM**

Protect water aquifers

**Action:**

Create and enforce zoning (land use) to protect primary recharge areas.

Time Frame: Ongoing enactment of ordinances

Funding: Local government funding

Estimated Cost: TBD

Staff: Existing planners, planning commissions, engineers, and public officials

Background: Educate planners and formal adoption of ordinances

**Action:**

Watch countywide inventory data from public, private, and monitoring wells.

Time Frame: Ongoing

Funding: Local funds supplemented by grants made available

Estimated Cost: TBD

Staff: Health Department, USGS, and Emergency Management personnel coordinated effort

Background: Data has been available, but intra-agency coordination needs to be improved

**Hazard: Wildland Fire**

**Problem Identification:**

Lack of code enforcement within and awareness of the Wildland Urban Interface.

**Objective 1: Priority HIGH**

Take actions to enforce the codes that are currently in place.

**Action:**

Find personnel qualified to inspect property with regard to Wildfire Protection Standards

Time Frame: 6 months

Funding: N/A

Estimated Cost: None

Staff: City and county fire departments, Emergency Management and Engineering

Background: Regular Fire Warden duties stand in the way of inspection.

**Objective 2: Priority MEDIUM**

Educate persons living or working in these areas about the hazard.

**Action:**

Present Fire Wise workshops for residents of high-risk areas.

Time Frame: Ongoing

Funding: N/A (Fire Wise materials are provided free of charge)

Estimated Cost:

Staff: Fire Warden, fire personnel and county planners

Background: People are not being informed of potential hazards.

**Action:**

Inform people seeking building permits and realtors showing homes in these areas of the risk.

Time Frame: Ongoing

Funding: Local government funding

Estimated Cost: TBD

Staff: Fire Warden, fire personnel and county planners

Background: Potential homebuilders and buyers are not aware of the risk or the building codes to help mitigate the risk.

**Action:**

Determine the specific areas where the Wildfire Protection Standards are in effect and make it available to the public in a graphic form.

Time Frame: 6 – 12 months

Funding: N/A

Estimated Cost: None

Staff: County GIS Dept. and Emergency Management Staff

Background: Knowledge of these areas is vague and only passed on verbally.

**Hazard: Severe Weather****Problem Identification:**

Severe weather related incidents result in a large number of disaster declarations and emergency response needs.

**Objective 1: Priority MEDIUM**

Educate more citizens about recognizing and knowing the dangers of severe weather hazards.

**Action:**

Increase Weather Spotter training

Time Frame: Ongoing

Funding:

Estimated Cost: Minimal

Staff: Emergency Management Staff and National Weather Service Staff

Background: Weather Spotters add increased forewarning of severe weather.

**Action:**

Increase Amateur Radio Operator Involvement in weather observations.

Time Frame: Ongoing

Funding:

Estimated Cost: Minimal

Staff: HAM Radio Club, Emergency Management Staff

Background: HAM operators typically discuss weather in all communications.

**Note:** Tooele County is a NWS Storm Ready county and therefore we have done just about everything possible to mitigate severe weather incidents. This objective is just one more step beyond what we have already accomplished.

**Hazard: Infestation****Problem Identification:**

Negative economic impacts from grasshopper, Mormon Cricket, and other types of insects.

**Objective 1: Priority MEDIUM**

Establish continuous funding sources for countywide insect control

**Action:**

Provide historical data and other information to raise awareness levels of elected and appointed officials regarding infestation impacts and ripple effects.

Time Frame: On going

Funding: Local funds

Estimated Cost: TBD

Staff: USDA APHIS, UDAF, USU Extension and local governments

Background: Insect infestations are cyclic while insect control funding is not.

**Objective 2: Priority MEDIUM**

Utilize historical data to forecast infestation cycles and monitor pest populations to implement early prevention strategies.

**Action:**

Review research data and develop additional insect monitoring sites

Time frame: On going

Funding: USDA APHIS, UDAF, and USU Extension

Estimated Cost: TBD

Staff: USDA APHIS, UDAF, and USU Extension

Background: Understanding insect infestation cycles and early detection through monitoring can greatly reduce insect damage.

**Hazard: Earthquake****Problem Identification:**

Development on identified fault traces increase the risk to life and property following an earthquake.

**Objective 1: Priority HIGH**

Reduce the threat to life and property within anticipated fault zones.

**Action:**

Develop and implement land use ordinances.

Time Frame: Ongoing

Funding: Local governmental funding

Estimated Cost: Minimal

Staff: Existing planners, planning commissions, engineers, and public officials.

Background: Existing faults have already been identified and are monitored.

**Objective 2: Priority HIGH**

Take advantage of continuing education opportunities for planners and policy officials

**Action:**

Attend ACT-21 classes

Time frame: Ongoing

Funding: Local government funding

Estimated Cost: Minimal

Staff: Existing planners, planning commissions, engineers, and public officials

Background: ATC-21 Training is a pre-earthquake assessment of buildings course helpful in determining the potential danger of a building.

**Action:**

Collect building data for input into computer earthquake models.

Time Frame: 6-12 months

Funding: N/A

Estimated Cost: None (can be done in house)

Staff: Emergency Management Staff, Planners, and Inspectors

Background: No current data on building inventory for use in damage and cost loss models in the event of an earthquake.

## **H. Maps**

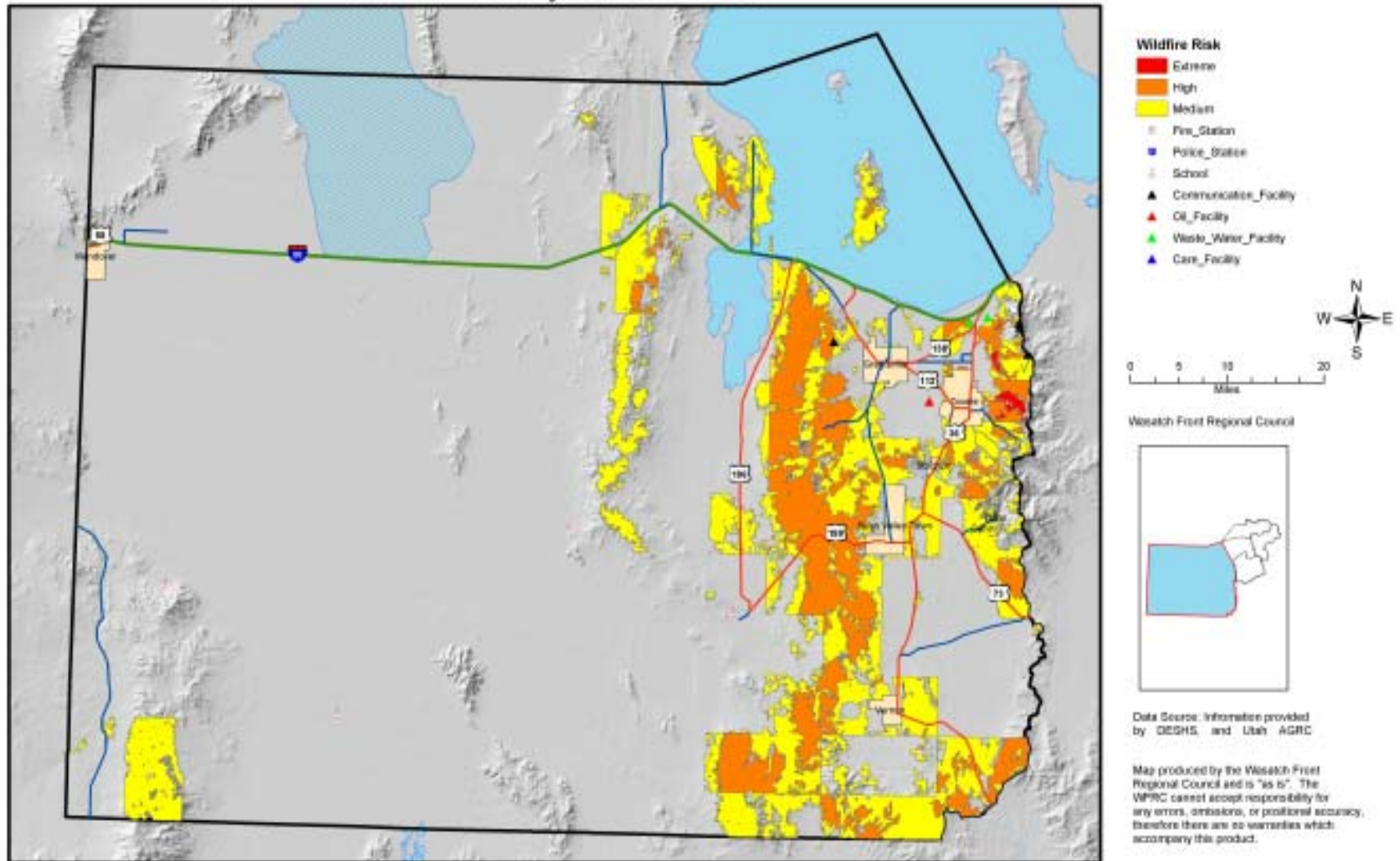
All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 10.1.1 Tooele County Wildfire Risk

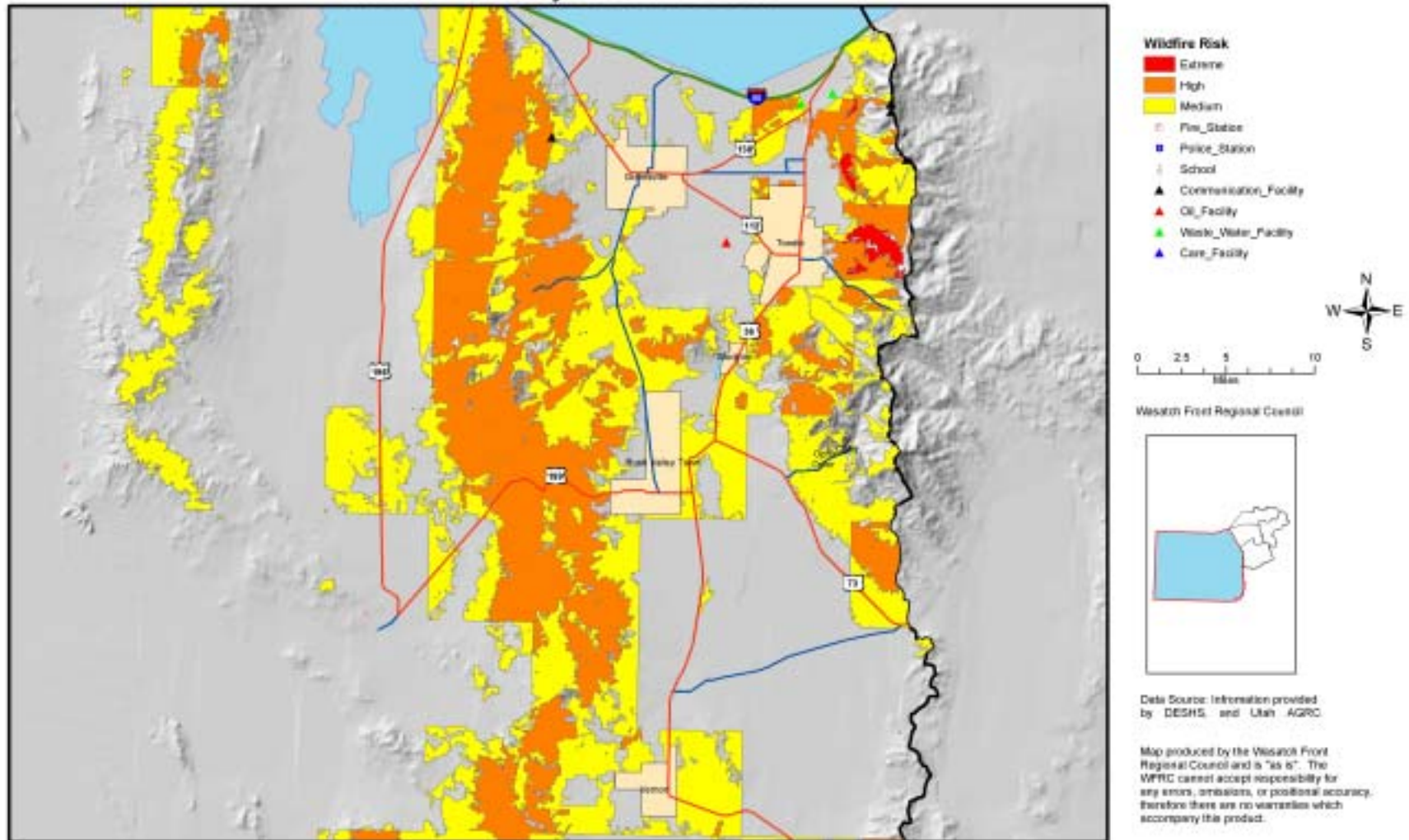
Map 10.1.2 Wildfire Risk

Map 10.2.1 Tooele County Earthquake Risk

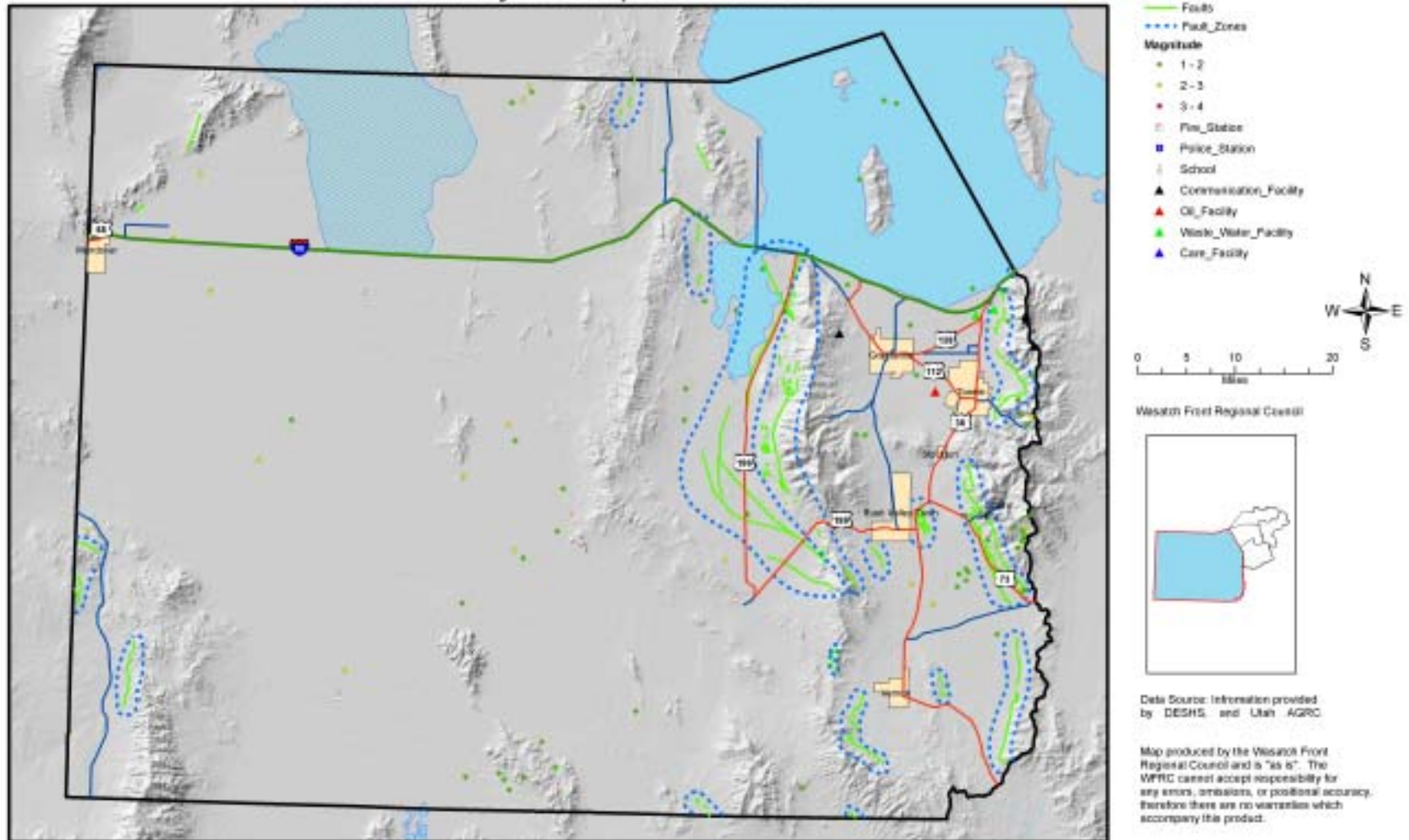
## Tooele County Wildfire Risk



## Tooele County Wildfire Risk

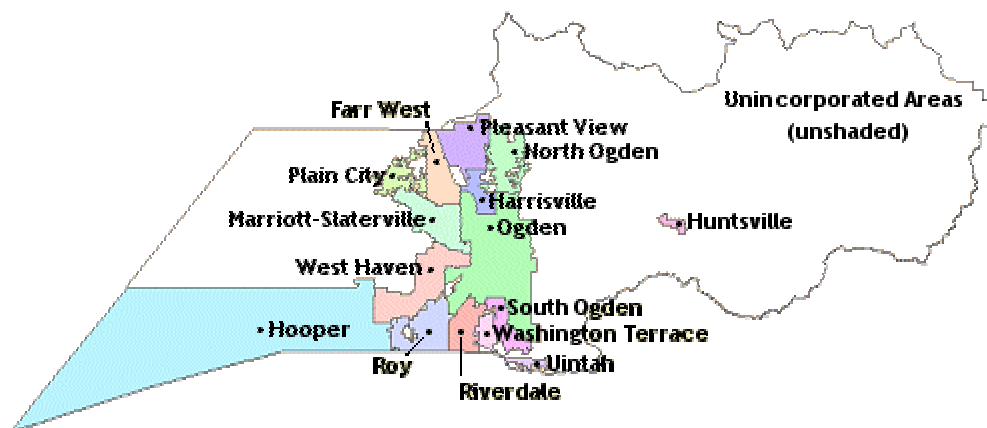


## Tooele County Earthquake Hazard



## Part XI. Weber County

Weber County includes fifteen municipalities: Farr West City, City of Harrisville, Hooper City, Huntsville City, Marriott-Slaterville, North Ogden City, Ogden City, Plain City, Pleasant View City, Riverdale City, Roy City, South Ogden City, Town of Uintah, city of Washington Terrace, and West Haven City. Ogden City is the County seat for Weber County and is also a hub for northern Utah. Ogden City is Utah's sixth largest city. Most of Weber County is considered to be a high alpine mountain valley, however, the western portion is a flat fertile plain formed by alluvial deposits from ancient Lake Bonneville.



### A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. The following data include population projections into the year 2030 according to the Census 2000 data (Table 11-1).

**Table 11-1 Population**

Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990- 2000	Percent Change 1990- 2000	AARC 1990- 2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Weber County	158,330	196,533	38,203	24.1%	2.2	4	5	15	15
Population by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Weber County	144,616	158,330	196,533	211,207	237,877	265,905	286,919	320,770	1.65%

<b>Households by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000- 2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Weber County	47,643	53,111	65,698	71,436	81,414	91,518	99,699	113,835	1.85%
<b>Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000- 2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Weber County	9.90%	9.19%	8.80%	8.57%	8.53%	8.50%	8.51%	8.50%	-0.11%
<b>Household Percent of State Total by County and Multi-County District</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Weber County	10.62%	9.89%	9.37%	9.01%	8.90%	8.80%	8.73%	8.61%	-0.28%
<b>Average Household Size by County and Multi-County</b>									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Weber County	2.99	2.94	2.95	2.91	2.88	2.86	2.84	2.77	-0.20%
Source Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget. 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes. Note AARC is average annual rate of change.									

## B. Economy

The Weber County 2001 job market has slowed and jobs were even lost due to a nationwide recession. The current jobless rate is between 4-5% for the county. Continued population growth has also contributing to the jobless rate. Twenty three percent of all jobs are in the "goods producing" industry of construction and manufacturing, while seventy seven percent of all other workers are in the "service industries" of transportation, trade, finances, services, and government. Government employment is twenty one percent, higher than the national average of fifteen percent. Total personal income for Weber County in 2000 and 2001 was \$4,489 million and \$4,610 million respectively. The 2001 per capita income was \$22,986 and the average monthly non-farm wage for 2001 was \$2,287. Utah Workforce Services identifies Weber County's largest employers (Table 11-2).

**Table 11-2 Annual Averages 2002 Company Industry Employment**

Company	Industry	Employment
Internal Revenue Service	Federal Gov.	5,000-6,999
Weber School District	Public Education	3,000-3,999

Weber State University	Higher Education	3,000-3,999
Autoliv	Motor Vehicle Equipment	2,000-2,999
McKay-Dee Hospital Center	Health Care	2,000-2,999
Fresenius USA Mfg. Inc.	Medical Instrument Mfg.	1,000-1,999
Convergys	Telephone Call Center	1,000-1,999
Wal-Mart	Discount Department Store	1,000-1,999
State of Utah	State Government	1,000-1,999
Ogden School District	Public Education	1,000-1,999
Source: Utah Department of Workforce Services, Workforce Information, Updated September 2003.		

## C. Transportation and Commuting Patterns

The major transportation routes within Weber County include I-15, a major transportation route that runs north south from Roy, in the Davis County area, north into Pleasantview, in the Box Elder County area. I-84 is another major transportation route that runs east west. Other major arteries include Highway 89, State Route 126 (1900 West), State Route 203 (Harrison Blvd.), State Route 204 (Wall Ave.), State Route 26 (Riverdale Rd.), State Route 79 (30-31<sup>st</sup> St.), State Route 53 (24<sup>th</sup> St.), State Route 39 (12<sup>th</sup> St.), and State Route 104 (20<sup>th</sup> St.). Refer to the Long Range Plan for 2020-projected average weekday traffic by Wasatch Front Regional Council for more information regarding commuting patterns and numbers. Table 11-3 from the Utah Department of Transportation represents 2002 Annual Average Daily Traffic for Weber County. Two major rail lines are also located in the county, as well as spur lines, and a large rail-switching yard. The Union Pacific Railroads has major operations within the county, and Ogden City continues to be a major rail hub.

**Table 11-3 2002 Annual Average Daily Traffic**

Artery Name	North-South	Entering	East-West	Exiting
State Route 26	36,505	South Ogden		Roy
State Route 39		Plain City, 4700 West	10,805	Into Morgan County
State Route 53		West Ogden	12,040	Harrison Blvd.
State Route 79		SR 126	14,305	SR 203
State Route 104		1900 West	14,970	Harrison Blvd.
State Route 126	25,664	I-89		200 North
State Route 203	34,660	SR 39		I-89
State Route 204	21,538	I-89		SR 26
Highway 89	30,575	North end of County		South end of County
I-15	84,484	North end of County		South end of County
I-84		Weber Canyon	13,191	Davis County

## D. Land Use

Weber County is a total of 644 square miles, composed of the following land ownership categories; Private lands 73.6%, Federal Government 18.2%, State Government 8.3%, Military and Bankhead Jones land 1.0%

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. Projections for the Wasatch Urban Area Long Range Transportation Plan: 2002-2030 are based on individual city and county land use assumptions. A majority of the region is expected to be developed for residential uses. These local master plans call for relatively low-density development patterns, with some pockets of denser activity. This pattern holds true for non-residential development as well as residential development. Large areas of industrial/warehouse development are planned in western Salt Lake City, along the I-15 corridor, and around Hill Air Force Base. High-density office and commercial developments are focused mainly in the Salt Lake and Ogden central business districts, with smaller commercial areas located in southern Salt Lake County, northern Davis County, and southern Weber County. Additional, smaller nodes of commercial and retail development are dispersed throughout urban and rural portions of Salt Lake, Davis, and Weber Counties.

A significant portion of Weber Counties is currently zoned for low-density residential development. Some higher density housing is being built in Ogden City's Canyon Road Community. Industrial land uses are located at the redeveloped Business Depot Ogden (the former Ogden Defense Depot), Hill Air Force Base, the Ogden City Industrial Park and Clearfield's Freeport Center. Areas for commercial land uses include linear concentrations along major arterial roads including Riverdale Road, the southeastern portion of Harrison Blvd., 12th Street between Washington Blvd. and I-15, Hill Field Road near the Layton Hills Mall, State Street (Layton and Clearfield) and Main Street (Kaysville, Clearfield and Sunset). The McKay-Dee Hospital has moved to a new 62-acre location on Glassman Way. Additional commercial nodes are dispersed throughout the Ogden/Layton Urbanized Area to serve adjoining residential communities.

The principal Ogden/Layton Urbanized Area traffic generators are associated with large employment centers as well as with commercial office, retail and industrial land uses. The most significant traffic generator is Hill Air Force Base that employs over 10,000 skilled workers. This employment center is expected to remain the major traffic generator for the greater metropolitan region.

Major traffic generators within the Ogden/Layton Urbanized Area include Ogden City's Central Business District, Hill Air Force Base, Weber State University and the McKay-Dee Hospital Center. Major nodes of commercial development include the Lagoon Amusement Park, Layton Hills Mall, Newgate Mall, and other office/retail developments in Layton, Clearfield and Roy City. Major nodes of industrial development include the Ogden City Industrial Park, the Business Depot Ogden, the Clearfield Freeport Center and Roy City's Iomega complex located on 1900 West

These are just some examples of the mitigation actions that can be put into place when new development occurs. Specific mitigation actions for Weber County can be found in Section G.

## **E. Risk Assessment**

The risk assessment process revealed the following for Earthquake, Flood, Severe Weather, Wildland Fire, Dam Failure, and Landslide/Slope Failure. Severe Weather is considered to be a regional hazard and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are 31 critical facilities in Weber County, for the complete list refer to Appendix D.

# 1. Earthquake

## Hazard Profile

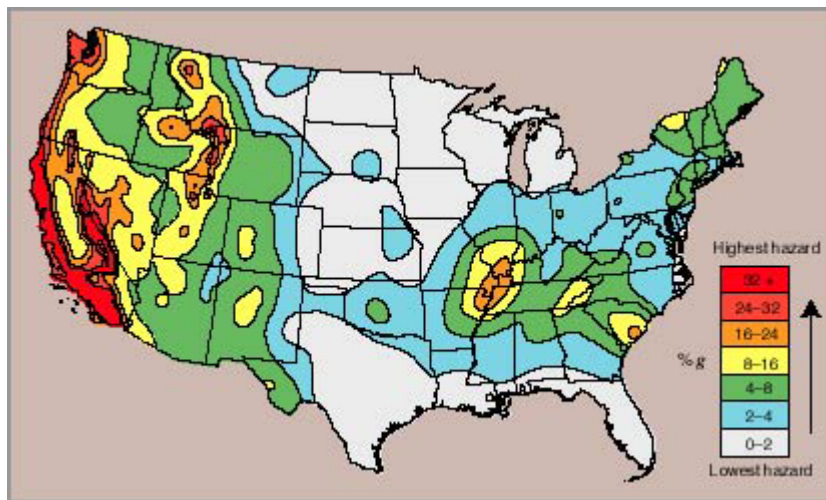
Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Western Portion along the Intermountain Seismic Belt will probably be the most affected. Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault, Weber Segment.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

## Description of Location and Extent

In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years. Within Weber County runs the Weber Segment of the Wasatch Fault Zone from North Salt Lake along the eastern edge of the valley to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years making it one of the most active fault segments. The Weber County segment of the Wasatch Fault could therefore create a magnitude 7.0 or above earthquake which would be very damaging to the entire county.

Two major earthquakes have struck the Ogden City area with a Richter magnitude between 5.0 and 5.5 since 1894. Weber County has also felt earthquakes that did not have their epicenters within the county. According to the Weber County Emergency Operations Plan in 1962 an earthquake with its epicenter in Richmond, along the Cache fault, produced a 5.7 Richter magnitude earthquake. Others include a 6.0 in the Pocatello Valley along the Hansel Valley Fault in 1975, and another on the same fault in 1934 with a magnitude of 6.6, yet another in 1909 with a 6.0 magnitude. Four earthquakes had their epicenters in Salt Lake between 1910 and 1962 that produced magnitude 5.0-5.2 earthquakes. The following hazard map identifies northern Utah as having a moderate to high percent of ground motion hazard (Figure 11-1).

**Figure 11-1 Probabilistic Seismic Hazard Map provided by USGS**



Using latitude and longitude, earthquake ground motion can be looked up on the USGS website for each city within Weber County. This table identifies ground motion hazard values, Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These will be expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years (Table 11-4).

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but of course is only approximate due to building design and demand. The probability of exceedence is based on average probability per year, all probabilities are added, and a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain number of years. The values listed are for the nearest grid point in decimal degrees range from 40.90000 to 41.00000 latitude and -68.20000 to -68.70000 longitude.

For a more detailed explanation of values used and metadata refer to the [USGS Earthquake Hazards Program](#) website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage. The city of Marriott-Slaterville's was unable to be identified for earthquake probabilistic hazard values.

**Table 11-4 Earthquake Probabilistic Hazard- Ground Motion Values**

<b>Pleasant View City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9317178	1.488349	2.553365
0.2 sec SA	2.415735	3.756257	6.646093
0.3 sec SA	2.220395	3.529207	6.014318
1.0 sec SA	0.9748755	1.729893	3.281561
<b>Plain City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9021723	1.410087	2.470716
0.2 sec SA	2.347333	3.661370	6.320310
0.3 sec SA	2.150422	3.434498	5.699156
1.0 sec SA	0.9396642	1.688893	3.178224

<b>North Ogden City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9612721	1.566727	2.637966
0.2 sec SA	2.483814	3.936054	6.971746
0.3 sec SA	2.289441	3.623435	6.329513
1.0 sec SA	1.008761	1.769674	3.382588
<b>Ogden City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8952948	1.395749	2.459433
0.2 sec SA	2.329926	3.641713	6.267258
0.3 sec SA	2.130496	3.410842	5.675544
1.0 sec SA	0.9277532	1.675351	3.145885
<b>Roy City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8643962	1.344493	2.372246
0.2 sec SA	2.258103	3.541866	5.919023
0.3 sec SA	2.056691	3.310885	5.557192
1.0 sec SA	0.8905621	1.632116	3.036700
<b>Hooper City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8306169	1.303367	2.272849
0.2 sec SA	2.179690	3.431073	5.638390
0.3 sec SA	1.976373	3.200925	5.425649
1.0 sec SA	0.8507870	1.585771	2.918750
<b>Huntsville City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	1.053631	1.707152	2.925023
0.2 sec SA	2.720260	4.384018	7.544168
0.3 sec SA	2.416321	3.795420	6.872267
1.0 sec SA	1.071235	1.843178	3.568560
<b>City of Harrisville</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9260030	1.478219	2.548031
0.2 sec SA	2.400999	3.741378	6.613659
0.3 sec SA	2.202933	3.509743	5.964895
1.0 sec SA	0.9633222	1.717045	3.252022
<b>Farr West City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9317178	1.488349	2.553365
0.2 sec SA	2.415735	3.756257	6.646093
0.3 sec SA	2.220395	3.529207	6.014318
1.0 sec SA	0.9748755	1.729893	3.281561

<b>Cities of Riverdale &amp; Washington Terrace</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8952948	1.395749	2.459433
0.2 sec SA	2.329926	3.641713	6.267258
0.3 sec SA	2.130496	3.410842	5.675544
1.0 sec SA	0.9277532	1.675351	3.145885
<b>South Ogden City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9260030	1.478219	2.548031
0.2 sec SA	2.400999	3.741378	6.613659
0.3 sec SA	2.202933	3.509743	5.964895
1.0 sec SA	0.9633222	1.717045	3.252022
<b>Town of Uintah</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8864052	1.376026	2.442762
0.2 sec SA	2.308044	3.615665	6.192405
0.3 sec SA	2.106282	3.381259	5.644844
1.0 sec SA	0.9136880	1.659383	3.107541
<b>West Haven City</b>	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8643962	1.344493	2.372246
0.2 sec SA	2.258103	3.541866	5.919023
0.3 sec SA	2.056691	3.310885	5.557192
1.0 sec SA	0.8905621	1.632116	3.036700

Weber County is located atop an ancient Lake Bonneville, which is made up of very weak soils. The area is also subject to shallow ground water and a relatively high earthquake threat. The secondary threat, liquefaction associated with an earthquake could have a higher impact on the county than the surrounding areas. For a further explanation of liquefaction see Map 11.1.2 titled Weber County Liquefaction Potential. The regional hazard identification section also explains liquefaction in a narrative form.

The following figures identify Weber County liquefaction potential recognized by the Utah Geological Survey (Figure 11-2), and a Weber County Fault Map (Figure 11-3).

# LIQUEFACTION-POTENTIAL MAP FOR A PART OF WEBER COUNTY, UTAH

**UTAH GEOLOGICAL SURVEY**  
*Public Information Series 27*  
August 1994

**LIQUEFACTION POTENTIAL**

- High
- Moderate
- Low
- Very Low

Landslides

N

SCALE 1:200,000

0 1 2 3 4 5 MILES  
0 1 2 3 4 5 KILOMETERS

The map displays the following features:

- Towns and Locations:** Plain City, Ogden, Roy, North Ogden, and areas near Great Salt Lake.
- Roads:** I-15, I-89, US-126, and local roads like Washington Blvd, Harrison Blvd, and 12th St.
- Geographic Features:** Weber River, Ogden Canyon, and Weber Canyon.
- Liquefaction Potential Zones:** High potential (brown) covers most of the western and central parts. Moderate (grey) is seen around Ogden and Roy. Low (green) is at the southern edge near Weber Canyon. Very Low (yellow) is along the eastern boundary.
- Landslides:** Indicated by hatched patterns, primarily along the southern edge near Weber Canyon.

BOX ELDER COUNTY

DAVIS COUNTY

Weber Canyon

Ogden Canyon

North Ogden Canyon

Great Salt Lake

Roy

Ogden

Plain City

Washington Blvd

Harrison Blvd

12th St

Weber River

I-15

I-89

US-126

Eberta Dr

2600 N

2700 N

5900 W

4700 W

4000 S

5500 S

5600 S

900 S

Richard Dr

Riverview Rd

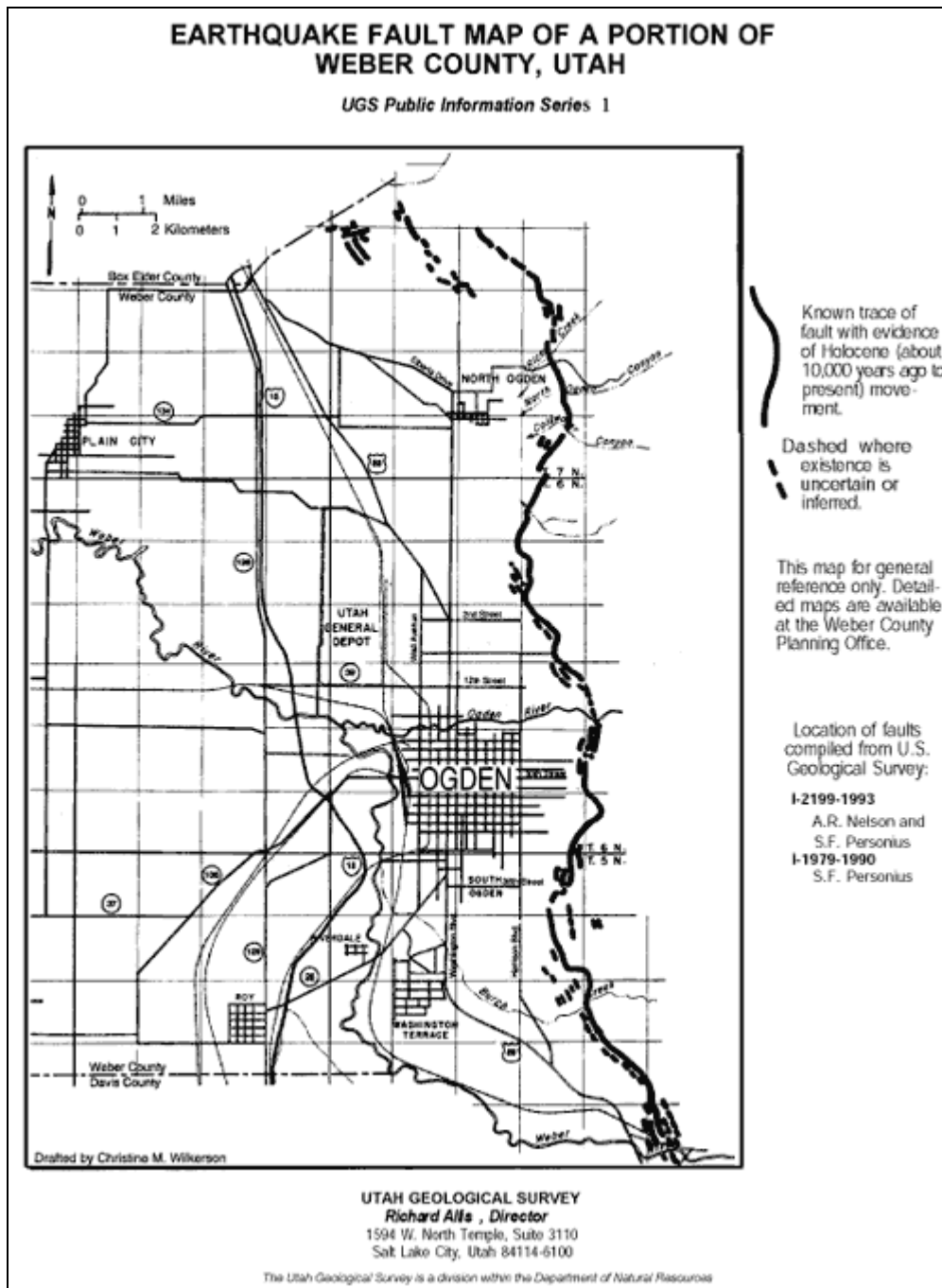
84

Digital compilation by Janine L. Jarva,  
Utah Geological Survey, facilitated by  
Automated Geographic Reference Center

This map is for general reference only and was modified from Anderson, L.R., Keaton, J.R., and Bay, J.A., 1994, Liquefaction potential map for the northern Wasatch Front, Utah: Utah Geological Survey Contract Report 94-5, 150 p., scale 1:48,000. Copies of this report are available at the Utah Geological Survey.

## Part XI. Weber County

Figure 11-3 Weber County Fault Map



Source: Earthquake Fault Map of a Portion of Weber County. Utah Geological Survey. Public Information Series 1. Richard Alf. 2003. < <http://geology.utah.gov/online/images/pi-1.gif> >.

### Vulnerability Assessment

The potential loss estimate tables below include the type and number of residential, commercial, and critical facilities located in the earthquake hazard area, as well as the population affected (Tables 11-5, 11-6, 11-7, 11-8).

**Table 11-5 Inventory of Critical Facilities Located in Earthquake Fault Zones**

<b>Facility Type</b>	<b>Name</b>	<b>City</b>
Communication Facility	KWCR-FM Ch 201	Ogden
Waste Water Facility	Plain City Corporation	Plain City
Care Facility	McKay-Dee Hospital Center	Ogden
Fire Station	Uintah Fire Dept	Ogden
School	St Joseph High School	Ogden
School	St Joseph Catholic Elementary	Ogden
School	St Paul Lutheran School	Ogden
School	Horizon Educational System	Ogden
School	Children's Classic	South Ogden
School	McKay Dee School	Ogden
School	School For The Deaf	Ogden
School	School For The Blind	Ogden
School	Lincoln School	Ogden
School	Lynn School	Ogden
School	Mound Fort Middle	Ogden
School	Mount Ogden Middle	Ogden
School	Ogden High	Ogden
School	Polk School	Ogden
School	Carl H Taylor School	Ogden
School	Thomas O Smith School	Ogden
School	Wasatch School	Ogden
School	Early Childhood	Ogden
School	Observ/Assess - Yic	Ogden
School	Ben Lomond High	Ogden
School	Bonneville School	Ogden
School	Central Middle	Ogden
School	Edison School	Ogden
School	Gramercy School	Ogden
School	Grandview School	Ogden
School	Highland Middle	Ogden
School	Horace Mann School	Ogden
School	Washington High	Ogden
School	Bates School	Ogden
School	Green Acres School	Ogden
School	Lomond View School	Ogden
School	Canyon View School	Ogden
School	Uintah School	Ogden
School	Weber High	Ogden

**Table 11-6 Property Inventory within Fault Zones**

City Name	City Area (Acres)	Acres in Fault Zone	Acres in Liquefaction Zone	Number of property structures within Fault Zones		Number of Structures within Liquefaction Zones		Population in Hazard Areas	
				Commercial/ Annual Sales	Residential/ Value	Commercial/ Annual Sales	Residential/ Value	Earthquake	Liquefaction
Farr West City	3,621	640	3483	6 / \$14,300,000	132 / \$16,654,808	63 / \$151,500,000	849 / \$104,082,386	155	1,485
Harrisville	1,641	216	468	38 / \$26,200,000	149 / \$14,651,241	24 / \$14,100,000	225 / \$18,688,944	753	169
Huntsville	498	0	0	0	0	0	0	0	0
North Ogden City	4,274	3,551	0	156 / \$94,900,000	3687 / \$443,417,723	0	0	9,941	0
Ogden City	17,137	9,224	8904	1306 / \$1,801,700,000	16379 / \$1,563,474,984	2319 / \$4,108,300,000	6801 / \$440,786,350	48,865	24,578
Plain City	2,509	3,778	2509	0	0	56 / \$67,200,000	1071 / \$119,568,186	0	1,904
Pleasant View	4,450	0	709	82 / \$65,400,000	1365 / \$203,012,929	11 / \$11,000,000	36 / \$3,660,083	3,414	40
Riverdale	2,664	0	2007	0	\$0	258 / \$615,500,000	1628 / \$176,719,167	0	5,352
Roy City	4,959	0	4796	0	0	668 / \$695,300,000	9423 / \$904,483,132	0	25,695
South Ogden	2,078	325	12	85 / \$97,100,000	935 / \$78,294,338	2 / \$800,000	4 / \$217,447	1,332	0
South Weber	10	3	0	0	0	0	0	0	0
Uintah	540	240	0	16 / \$16,700,000	111 / \$12,142,760	0	0	249	0
Washington Terrace	1,228	0	0	0	0	0	0	0	0
West Haven	6,559	0	6559	0	0	274 / \$418,100,000	1193 / \$158,118,781	0	3,016

**Table 11-7 Infrastructure in Earthquake Area**

Item	Length (Miles)	Replacement Cost
Local Roads	11.41	\$22,820,000
State Highways	31.74	\$76,604,490
US Highways	1.47	\$3,543,259
US Interstates	2.22	\$7,985,160
Power Lines	105.83	\$5,109,472
Gas Lines	0.00	\$0

**Table 11-8 Infrastructure in Liquefaction Area**

Item	Length (Miles)	Replacement Cost
Local Roads	62.14	\$124,280,000
State Highways	139.82	\$337,464,500
US Highways	5.53	\$13,358,481
US Interstates	16.98	\$61,141,680
Power Lines	339.94	\$16,412,303
Gas Lines	0.00	\$0

**HAZUS MH Vulnerability Assessment**

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 11-9 identifies the probable casualties during an earthquake.

**Table 11-9 Casualties**

Casualties	Nighttime –Minor	2,731
	Nighttime –Major	77
	Nighttime -Fatalities	149
	Daytime –Minor	3,381
	Daytime –Major	133
	Daytime- Fatalities	255
	Commute –Minor	3,049
	Commute –Major	112
	Commute-Fatalities	212

**Building Damage by Count**

HAZUS MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 11-10 lists the number buildings by occupancy that are estimated to have moderate to complete levels of damage. Table 11-11 identifies the critical facilities affected by an earthquake.

**Table 11-10 Building Damage by Count with Moderate to Complete Damage**

Category	Number of Structures
Residential	4,569
Commercial	458
Industrial	61
Totals	37,783*

\*Includes all building categories with moderate to complete damage

**Table 11-11 Critical facilities**

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	2	2	0	0
Schools	78	71	0	0
Emergency Operations Centers	0	0	0	0
Police Stations	8	8	0	0
Fire Stations	8	8	0	0

**Debris Removal**

Table 11-12 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

**Table 11-12 Debris Generated (millions of tons)/Loads to Remove Debris**

Debris Generated	1
Loads (25 tons per load)	40,000

**Fire Following**

The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS MH uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 11-13 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

**Table 11-13 Fire Following Event, Population Exposed, and Building Stock Exposed**

Ignitions	25
People Displaced	426
Value Exposed (mill. \$)	20

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

## 2. Dam Failure

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Dam locations are mainly in the central and western portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

### Description of Location and Extent

Fifteen dams are located in Weber County with eight dams listed as having a high hazard threat meaning if they fail they have a high probability of causing loss of life and extensive economic loss. Seven dams are listed as being moderate meaning if they fail they have a low probability of causing loss of life but would cause appreciable property damage. None of Weber County's dams have a low hazard threat, which means if they were to fail there would be a minimal threat to life and economic losses would be minor and the damage would be limited to the owner of the dam. (Table 11-10).

It should be noted that Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State Engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

### Vulnerability Assessment

A vulnerability assessment for dam failure was difficult to analyze due to the quality and age of the dam inundation maps from the Dam Safety Section of Utah Water Rights. Critical facilities were identified that were within the inundation areas for the high hazard dams and these facilities are listed in Table 11-14. However, due to the lack of digitized dam inundation maps, potential losses not able to be identified. Refer to Map 11.2.1 Weber County Dam Hazard for dam locations. Moderate Hazard Dams include Ogden City Beus Pond, Uintah Mountain Stream, Utaba Retarding, Kelly Canyon, Pleasant View Reservoir, Fourmile Debris Basin- Harrisville Dam, and Sourdough Wilderness Ranch.

**Table 11-14 Dam Inventory of High and Moderate Hazard Dams**

Causey Dam	
Owner	Department Of Interior Bureau of Reclamation- Federal. Operated by Weber Basin Water Conservancy District
River	South Fork Ogden River
Near City/ Distance	Huntsville/ 11
Year Completed	1965
Dam Length	845
Dam Height	195

Max Discharge	13450
Max Storage	8730
Normal Storage	7870
Surface Area	175
Drainage Area	81
Spill Type/ Width/ Volume	U/ 25/ 1,400,000
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	5/25/1993
Critical Facility in Inundation Area	Property and infrastructure below dam. No identifiable critical facility in inundation zone

<b>Pineview</b>	
Owner	Department Of Interior Bureau of Reclamation- Federal. Operated by the Ogden River Water Users Association
River	Ogden River
Near City/ Distance	Hermitage/ 2
Year Completed	1937
Dam Length	600
Dam Height	95
Max Discharge	10000
Max Storage	116150
Normal Storage	110150
Surface Area	2920
Drainage Area	298
Spill Type/ Width/ Volume	C/ 24/ 418,000
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	10/24/1990
Critical Facility in Inundation Area	Homes and property below dam. No identifiable critical facility in inundation zone

<b>North Ogden City Coldwater Canyon</b>	
Owner	North Ogden City- Local Government
River	Coldwater Creek
Near City/ Distance	North Ogden City/ 0.1
Year Completed	1983
Dam Length	1200
Dam Height	38
Max Discharge	872
Max Storage	11
Normal Storage	5
Surface Area	0
Drainage Area	2
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	04/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

<b>Ogden City- Sullivan Hollow</b>	
Owner	Ogden City Corporation- Local Government
River	Sullivan Hollow
Near City/ Distance	Ogden/ 0.1
Year Completed	1974
Dam Length	405
Dam Height	18
Max Discharge	515
Max Storage	21
Normal Storage	19
Surface Area	2
Drainage Area	4
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/29/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

<b>South Ogden City Burch Creek Debris</b>	
Owner	South Ogden City- Local Government
River	Burch Creek
Near City/ Distance	South Ogden - 0.1
Year Completed	1985
Dam Length	330
Dam Height	56
Max Discharge	420
Max Storage	122
Normal Storage	80
Surface Area	4
Drainage Area	4
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

<b>North Ogden City Coldwater Desilting</b>	
Owner	North Ogden City- Local Government
River	Coldwater Creek
Near City/ Distance	North Ogden- 0.1
Year Completed	1986
Dam Length	325
Dam Height	20
Max Discharge	104
Max Storage	20
Normal Storage	15
Surface Area	2
Drainage Area	2.5

Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

<b>South Ogden City Burch Creek / Glasmann</b>	
Owner	South Ogden City- Local Government
River	Burch Creek
Near City/ Distance	South Ogden/ 0.5
Year Completed	1992
Dam Length	713
Dam Height	34
Max Discharge	1550
Max Storage	42
Normal Storage	2
Surface Area	0
Drainage Area	3.8
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

<b>North Ogden Orton Park/ 2100 North</b>	
Owner	North Ogden City- Local Government
River	Coldwater Creek/ Fourmile
Near City/ Distance	North Ogden/ 0.1
Year Completed	1990
Dam Length	2340
Dam Height	8
Max Discharge	400
Max Storage	3
Normal Storage	2
Surface Area	8
Drainage Area	10
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	Elementary School on Monroe Blvd and 2025 North.

<b>Northwest</b>	
Owner	Northwest Irrigation Co
River	Cottonwood Creek
Near City/ Distance	Mountain Green/ 2
Year Completed	1940

Dam Length	800
Dam Height	36
Max Discharge	30
Max Storage	603
Normal Storage	523
Surface Area	25
Drainage Area	0
Spill Type/ Width/ Volume	B/ 0/ 0
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

Other dams outside the County boundaries could also affect Weber County. Echo Dam, located between Morgan and Park City; The Wanship Dam - Rockport Reservoir, located upstream from Echo Dam; East Canyon Dam, south of Morgan City; and Lost Creek Dam northeast of Morgan City; as well as AV Watkins Dam - Willard Reservoir/ Willard Bay, located in Box Elder County on the northern border of Weber County. Willard Bay is a diked bay of the Great Salt Lake that holds over 215,000 acre-feet of water. If it were to breach, water from the reservoir could flood much of the northwestern portion of Weber County.

If an earthquake with a magnitude of 6.0 or greater were to occur within 14 miles of epicenter latitude of 41.18333 and epicenter longitude of 111.93667 the dams in Table 11-15 Earthquake Dam Hazard would be affected.

**Table 11-15 Earthquake Dam Hazard**

Dam Name	Hazard Rating	Miles from Epicenter	County
Combe Equalizing Reservoir	High	1.29	Weber
S. Ogden City Burch Creek- Glasmann	High	1.35	Weber
S. Ogden City Burch Creek Debris	High	1.65	Weber
Ogden City- Sullivan Hollow	High	2.06	Weber
Spring Creek- Weber		2.64	Weber
Military Springs		4.21	Weber
Sinclair Oil Corp		4.62	Weber
Sinclair Oil Corp		4.62	Weber
Forest Service		5.63	Weber
Hobbs	High	5.83	Davis
Davis/ Weber County Canal Co. Sunset Pond	High	5.89	Davis
Davis/ Weber County Canal Co. Layton Pond	High	6.84	Davis
Pineview	High	7.00	Weber
Clinton Detention Basin		7.49	Davis
N. Ogden City Orton Park/ 2100 North	High	7.79	Weber
Adams	High	7.82	Davis
Holmes	High	7.90	Davis
Northwest	High	8.88	Morgan
Davis/ Weber County Canal Co. Kaysville	High	9.01	Davis
Davis County- Holmes Creek Detention Basin	High	9.02	Davis
Hawk's Landing #4 Gate Pond		9.07	Weber
Hawk's Landing #1 Church Pond		9.07	Weber
Hawk's Landing #2 Middle Pond		9.07	Weber

Hawk's Landing #3 Old Storage Pond		9.07	Weber
Carrigan and Bowman		9.17	Morgan
Kaysville	High	9.32	Davis
Wilkinson- Harry	High	9.55	Morgan
Babcock, Mike		9.66	Morgan
N. Ogden Pond #2		9.90	Weber
Haight Creek, Lower	High	10.15	Davis
Nibley, Preston and Elizabeth		10.61	Weber
Haight Creek, Upper	High	10.65	Davis
Ken Gardner/ John Lewis		10.98	Weber
Eden Pond		11.04	Weber
N. Ogden Pond #1		11.08	Weber
Wolf Creek Reservoir	High	11.14	Weber
Bartons Pond- Bountiful Blvd Detention Basin		11.27	Davis
Hirschi, Scott and Tod Jones		11.61	Davis
Whitear		12.00	
Davis County- Shepard Creek Detention Basin	High	12.32	Davis
Farmington Equalizing Reservoir	High	12.96	Davis
Arthur V. Watkins		13.57	Box Elder
Davis County- Farmington Pond	High	13.59	Davis
Farmington Irrigation- Reservoir B	High	13.73	Davis

### 3. Flood

#### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Flooding mainly takes place in the western portion of the county where the land is flat.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

#### Description of Location and Extent

The greatest flood risk in the past in Weber County is associated with cloudburst storms. In the future this will also be the main threat. Cloudburst storms generally result in flash flooding in very localized areas. Rapid snowpack melt is another significant flood threat that results in unusually heavy water.

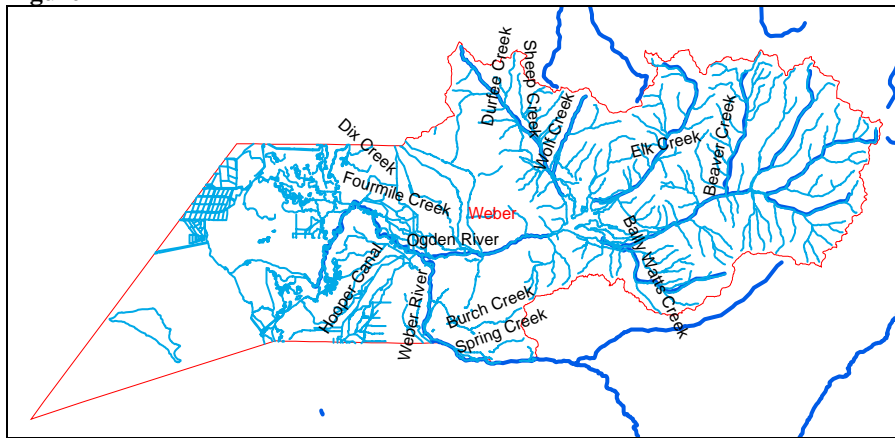
The greatest flood potential is within western Weber County, Ogden, and the Weber River in Uintah City, as well as locations away from the foothills where the land is flat. The Weber and Ogden Rivers can experience flooding, however the threat is fairly low due to the dams located above stream. The dams can control the floodwater and therefore most of the flood potential can be mitigated. Other smaller creeks that can create flood problems within the county include North Fork Ogden River, South Fork Ogden River, Upper Valley, Taylor Canyon Creek, Wolf Creek, Waterfall Canyon Creek, Beus Canyon Creek, Burch Creek, Cold Water Canyon Creek, Four Mile Creek, Six Mile Creek, and Hot Springs Creek. The Weber River drainage is approximately 2,460 square miles (Weber County Emergency Operations Plan). The Warren area could experience flooding on agricultural lands and some homes from the confluence of the Weber and Ogden Rivers. In the past businesses and roads were damaged from flooding between 1990 West and 1300 South near SR89 in Warren. Refer to Figure 11-4 for a map of the larger streams in the County.

Two irrigation canals within Weber County affect the flood threat, the Weber-Davis Canal and the Ogden-Bingham Canal. The Weber-Davis Canal breached in 1999 and flooded over 70 homes. This event was declared as a city, county, and state disaster. The Ogden-Bingham Canal has also breached, caused by a rockslide in 1979. Since 1853 the county experienced over 360 flash floods and more than 170 snow melt floods.

#### Vulnerability Assessment

At this time, a vulnerability assessment was unable to be performed due to the lack of digitized floodplain maps and datasets used to conduct the assessments for the other natural hazards that affect the county. However, current mapping projects are being completed by the State that will result in better data and therefore a greater understanding of risk. The county would like to continue to work with the state to understand their threats; therefore general mitigation goals have been included. A Flood Hazard Identification Study has also been compiled by the Army Corps of Engineers in 2003, this study can be found in Appendix G.

**Figure 11-4**



## 4. Wildland Fire

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

### Description of Location and Extent

Potential wildfire hazard within Weber County is growing as population growth is spreading into wildland areas known as Urban-Wildland Interface Zones. Over the past 30 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property. According to the County Emergency Operations Plan the upper valley of Weber County will have one fire for every 80-100 years. However, humans have played a role in the fire cycle increasing the rotation to one for every 8-10 years. The county faces 50 fires in the wildland areas every year; 20% of which are caused by lightning, and 80% by humans. Most fires can be contained in a quarter-acre to one-acre area if they have not traveled into the wildland zones higher in the mountains, which are harder to fight due to steep mountain terrain.

Wildfire threat within the county is most severe in the Uintah Highlands area, east of Weber State University, the mouth of Ogden Canyon, Coldwater Canyon, upper east area of Harrison Blvd, North Ogden, Pleasantview, Wolf Creek, Powder Mountain, Maple Canyon, South Fork, and Snow Basin.

Wildfire maps were created using GIS and can be viewed in Section H Map 11.4.1 Weber County Wildfire Risk. The map layers were provided by DESHS and show three categories of wildfire risk:

- Extreme
- High
- Medium

These ratings cover all of Weber County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

### Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population within each of the areas is also included (Table 11-16). The critical facilities and infrastructure within the wildfire area can be found in Tables 11-17, and 11-18. Table 11-19 Wildfire Risk Area contains the number of acres in each wildfire risk area, within the municipal boundaries of the following cities in the county. Historical wildfires are referred to in Table 11-20.

**Table 11-16 Structures and Population in Wildfire Area**

City Name	City Area (Acres)	Acres in Extreme	Acres in High	Acres of Moderate	Number of Structures within Wildfire Risk Area		Population in Hazard Areas
					Commercial/ Annual Sales	Residential/ Replacement Value	
Farr West City	3,621	0	102	0	2 / \$12,700,000	11 / \$1,600,799	6
Harrisville	1,641	0	4	227	6 / \$7,000,000	116 / \$12,476,082	101
Huntsville	498	0	0	1	0	0	0
North Ogden City	4,274	744	350	7	8 / \$2,900,000	395 / \$69,318,084	734
Ogden City	17,137	354	550	567	23 / \$10,400,000	620 / \$149,725,574	1,045
Plain City	2,509	0	0	38	0	0	0
Pleasant View	4,450	675	348	304	1 / \$400,000	171 / \$39,590,966	122
Riverdale	2,664	18	367	34	51 / \$165,100,000	81 / \$8,185,550	31
Roy City	4,959	0	0	0	0	0	0
South Ogden	2,078	0	2	8	0	10 / \$809,192	0
South Weber	10	0	10	0	0	0	0
Uintah	540	0	29	36	0	40 / \$5657362	36
Washington Terrace	1,228	23	45	248	11 / \$7500000	219 / \$34,343,916	144
West Haven	6,559	0	0	14	0	0	0

**Table 11-17 Critical Facilities Within Wildfire Area**

Facility Type	Name	City	Wildfire Risk
School	Weber High	Ogden	Extreme
School	Snowcrest Jr High	Eden	Moderate
Police Station	Riverdale Police Dept	Riverdale	High

**Table 11-18 Infrastructure in Wildfire Area**

Item	Length (Miles)	Replacement Cost
Local Roads	5.59	\$11,180,000
State Highways	0.12	\$289,620
US Highways	5.53	\$13,358,481
US Interstates	1.31	\$4,725,360
Power Lines	75.49	\$3,644,657
Gas Lines	0.00	\$0

**Table 11-19 Wildfire Risk Area**

<b>City Name</b>	<b>Acres of Extreme</b>	<b>Acres of High</b>	<b>Acres of Moderate</b>
Farr West City	0.00	102.34	0.00
Harrisville	0.00	4.34	227.00
Huntsville	0.00	0.00	0.93
North Ogden City	744.12	350.02	6.77
Ogden City	354.08	549.77	566.81
Plain City	0.00	0.00	38.25
Pleasant View	675.06	348.06	304.28
Riverdale	17.77	367.03	34.48
Roy City	0.00	0.00	0.00
South Ogden	0.00	2.42	8.19
South Weber	0.00	10.10	0.34
Uintah	0.04	28.87	36.43
Washington Terrace	23.20	45.49	248.27
West Haven	0.00	0.00	13.75

**Table 11-20 Historical Wildfires**

<b>Date</b>	<b>Fire Name</b>	<b>Cause</b>	<b>Size</b>
8/13/88	Sawmill Li	Lightning	300 - 999 Acres
7/31/90	Long Bench	Children	300 - 999 Acres
8/5/91	Weber Canyon	Railroad	300 - 999 Acres
6/26/94	Middle Fork	Campfire	300 - 999 Acres
6/29/94	Maple Canyon	Children	300 - 999 Acres
7/2/94	Little Mt	Cigarette	300 - 999 Acres
8/4/94	Uintah Fire	Railroad	300 - 999 Acres
10/6/96	Spillway	Debris Burn	300 - 999 Acres
8/24/99	Beaver Creek	Debris Burn	300 - 999 Acres
8/24/88	Powder Mtn.	Equipment	1000 - 4999 Acres
8/30/94	Gun Range	Incendiary	1000 - 4999 Acres
7/29/95	Wolf Creek Fire	Children	1000 - 4999 Acres
8/7/00	Eagle Fire	Lightning	1000 - 4999 Acres

## 5. Landslide/ Slope Failure

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

### Description of Location and Extent

Future landslide areas are usually located in the areas of historical landslides, which are well-defined localized areas. Historically landslides have been one of the most naturally re-occurring hazards within Weber County. The homes found along the benches in the canyons have the greatest risk of rockfalls, debris flows, landslides, and other types of slope failure.

Within Weber County landslides have been identified in Ogden Canyon and Washington Terrace. The Ogden Canyon slide is south of the canyon mouth and forms a 200 foot high bluff above the south bank of the Ogden River, over 90 acres in size. Washington Terrace has a series of landslides four miles long, starting two miles west of the mouth of Weber Canyon and ending on the northwest side of Washington Terrace. Landslides can also be found in Ogden Canyon between the mouth and Pineview Dam. North Ogden Pass has evidence of sliding as well.

East of Plain City and Harrisville there is evidence of lateral spread more than 2000 ft. North central portion of the county there is evidence of slumps and earth flows and other deep-seated landslides. Extending north to south in the central portion of the county there are smaller (less than 2000 ft) lateral spread landslides. The eastern portions of the county exhibit rockfall, colluvial, talus, glacial, and soil-creep landslides larger than 2000 ft.

Three prominent rockslide areas are within the county. The North Ogden rockslide is 100 acres in size and is one mile northwest of the mouth of North Ogden Canyon. The College slide is another area that has slid in the past. The College rockslide is about 80 acres in size and is located east of the Weber State University campus. The third main rockslide area is known as Beus Canyon. This slide is one half mile square and is located immediately south of the College slide. Ogden Canyon, north of the mouth, is home to smaller rockslides. North of Taylor Canyon potential rockslide hazards exist.

Debris flows and mudslides are possible from the mouth of Weber Canyon to Riverdale, which could affect railroads, utilities, storm drainage lines, and residential property. Landsliding in the past has damaged several homes in this area. Erosion is a threat from Weber Canyon westward including the towns of Uintah and Riverdale. Homes, utilities, and bridges are at risk.

### Hazard Assessment

The number of residential structures contained within the landslide hazard risk may capture more or less structures than are actually at risk from landslides. In order to accurately capture landslide risks in these areas an assessment has been conducted using parcel data that identifies the people and property at risk including critical facilities and other types of infrastructure (Table 11-21, 11-22, and 11-23). The map 11.5.1 Weber County Landslide Hazard shows the locations at high-risk for landslides.

**Table 11-21 Inventory of Properties Located in High Landslide Risk Area in Weber County**

City Name	City Area (Acres)	Acres in Landslide Area	Population in Landslide Area	Number of property structures	
				Commercial/ Annual Sales	Residential/ Replacement Value
Farr West City	3,621	260	0	3 / \$6,900,000	5 / \$375,562
Harrisville	1,641	1425	2,328	96 / \$63,300,000	1059 / \$101,988,391
Huntsville	498	0	0	0	0
North Ogden City	4,274	1546	3,270	113 / \$120,700,000	1523 / \$151,291,224
Ogden City	17,137	5368	26,659	1,934 / \$2,704,500,000	7711 / \$727,072,328
Plain City	2,509	0	0	0	0
Pleasant View	4,450	1055	110	50 / \$41,200,000	218 / \$27,087,052
Riverdale	2,664	585	436	112 / \$190,800,000	283 / \$30,298,627
Roy City	4,959	0	0	0	0
South Ogden	2,078	992	4,567	194 / \$169,000,000	2035 / \$198,382,602
South Weber	10	0	0	0	0
Uintah	540	102	62	4 / \$600,000	29 / \$4,892,881
Washington Terrace	1,228	411	1,055	32 / \$17,400,000	506 / \$49,295,645
West Haven	6,559	0	0	0	0

**Table 11-22 Critical Facilities within Landslide Risk Areas**

Facility Type	Name	City
Communication Facility	KWCR-Fm Ch 201	Ogden
Waste Water Facility	Plain City Corporation	Plain City
Care Facility	McKay-Dee Hospital Center	Ogden
Fire Station	Ogden Fire Marshal	Ogden
Fire Station	North View Fire Station	Ogden
Fire Station	South Ogden Fire Station 1	Ogden
Police Station	Police Dept-Records	Ogden
Police Station	Washington Terrace Police	Ogden
Police Station	South Ogden Police Dept	Ogden
Police Station	Police Station	Ogden
School	St Paul Lutheran School	Ogden
School	Lincoln School	Ogden
School	Mount Ogden Middle	Ogden
School	Thomas O Smith School	Ogden
School	Wasatch School	Ogden

School	Edison School	Ogden
School	Grandview School	Ogden
School	Hillcrest School	Ogden
School	Lewis School	Ogden
School	Majestic School	Ogden
School	Club Heights School	Ogden
School	Green Acres School	Ogden
School	Marlon Hills School	Ogden
School	South Ogden Jr High	Ogden
School	Valley School	Huntsville

**Table 11-23 Infrastructure and Landslide Area**

<b>Item</b>	<b>Length (Miles)</b>	<b>Replacement Cost</b>
Local Roads	8.33	\$16,660,000
State Highways	33.89	\$81,794,239
US Highways	1.93	\$4,652,021
US Interstates	0.86	\$3,084,480
Power Lines	50.92	\$2,458,418
Gas Lines	0.00	\$0

## F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Table 11-24 identifies historic events with as much relevant information as was available including date, location, area impacted, and damage costs.

**Table 11-24 Hazard Histories**

<b>Hazard</b>	<b>Date</b>	<b>Location</b>	<b>Critical Facility/ Area Impacted</b>	<b>Comments</b>
Earthquake	July 18, 1894	Ogden		Richter magnitude 5.0
Avalanche	March 2, 1899	Ogden Canyon		Property Damage.
Earthquake	May 13, 1914	Ogden	Felt area 21,000 Sq. Kilometers	Richter magnitude 5.5 +/-
Flood	August 13, 1923		Tributaries between Ogden and Salt lake City	Intense thunderstorms. Seven deaths, \$3,000,000 in damage.
Drought	1930-1936	countywide		Recurrence Interval greater than 25 years.
Cloudburst	August 8, 1941	Ogden	Washington Ave, 24 and 25 <sup>th</sup> streets	Extensive flooding, damage to business establishments and homes.
Flash Flooding	May 17, 1949	Pleasant View	Ogden Valley	\$30,000 damage to farmlands and crops.
Flooding	April-June, 1952	Ogden	Ogden, Weber	Melting of snowpack. Declared Disaster.
Drought	1953-1965	countywide		Recurrence Interval 10-25 years.
Cloudburst	July 28, 1956	Ogden	East Bench, Weber Canyon	Flooding of homes and streets. Earthslides in canyon.
Avalanche	March 9, 1958	Snow Basin		Two deaths.
Lightning	June 10, 1960	Ogden		Two deaths.
Avalanche	March 29, 1964	Snow Basin		One death.
Thunderstorm	June 6, 1964	Ogden	Five Points area	Damage to homes and roads. Nordic Valley road flushed out.
Flooding from heavy rains	May 10-12, 1966	Ogden	North Fork of the Ogden River, North Ogden, east bench of Ogden	Damage to homes and streets.
Earthquake	March 5, 1967	Huntsville epicenter		Richter magnitude 3.0
Earthquake	December 7, 1967	Huntsville		Richter magnitude

		epicenter		3.6
Tornado	August 14, 1968	West Weber		F2. Property damage \$50,000 and one injury.
Lightning	June 10, 1969	Ogden		Two deaths.
Earthquake	September 23, 1971	East of Huntsville		Richter magnitude 3.1
Drought	1974-1978	countywide		Recurrence Interval 10-25 years.
Flooding	April-June 1983	Ogden	Tributaries between Ogden and Salt lake City	Rapid snowpack melt. Presidential Disaster Declaration.
Flooding	1983-1984	countywide		750 million in property loss. 3 deaths.
Waterspout	September 30, 1986	Great Salt Lake	North end of Antelope Island	
Waterspout	August 15, 1987	Great Salt Lake		
Tornado	April 23, 1990	Ogden	Farr West	Property damage.
Flood	09/1991	North Ogden		8.6 inches in less than 24 hours.
Mudslide/ Debris Flow	1991	North Ogden		Damaged more than 400 homes.
Tornado	December 5, 1995	Pleasant View		Property damage.
Tornado	May 29, 1996	North Ogden	West side of Washington Blvd.	F1. \$500,000 property damage. One injury.
Tornado	May 21, 1998	Roy		Property damage.
Tornado	August 20, 1998	Causey	Weber Memorial Campground	F0-F1. Property damage and seven people injured.

## G. Mitigation Goals, Objectives, and Actions

<b>Weber County</b> Pre-Disaster Mitigation FY 2003 (PDM03 Workbook)
--

County: Weber  
 Address: 721 West 12<sup>th</sup> Street  
 City: Ogden, UT  
 Zip Code: 84404

Point of Contact: Lance Peterson  
 Phone: 801-778-6682

Signature: \_\_\_\_\_  
 County/Tribal Emergency Management Director

Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group. Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

**Members of the County/Tribal PDM Working Group:**

Name: Lance Peterson	Title: Emergency Manager
Name: George Burbidge	Title: Weber County Stormwater
Name: Chuck Stokes	Title: Weber Fire Department
Name: Jack Lucero	Title: Weber Fire District
Name: Curtis Christenson	Title: Weber County Engineering
Name: Jay Miller	Title: Emergency Manager
Name: Delon Atkinson	Title: Emergency Services Director

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s). Include additional sheets of information as needed.

Date: November 4, 2003  
Time: 2:00 pm  
Place: Weber County Sheriff's Office

**Purpose of Meeting:**

Discuss mitigation strategies for natural hazards in Weber County

**List of Attendees:**

Lance Peterson  
Nancy Barr  
LaNiece Dustman  
Jim Boes  
George Burbidge  
Chuck Stokes  
Jack Lucero  
Curtis Christenson  
Jay Miller  
Delon Atkinson

**Summary of Meeting:**

The work group brainstormed and came up with mitigation goals and objectives for the county and its jurisdictions. The group then identified actions to accomplish the goals and objectives.

**Outcome of Meeting:**

Created a working group and mitigation workbook for future hazards.

\*The term "countywide" shall include the following jurisdictions: Farr West City, City of Harrisville, Hooper City, Huntsville City, Marriott-Slaterville, North Ogden City, Ogden City, Plain City, Pleasant View City, Riverdale City, Roy City, South Ogden City, Town of Uintah, city of Washington Terrace, and West Haven City.

**HAZARD: EARTHQUAKE**

**PROBLEM IDENTIFICATION:** Non-structural hazards in the Weber County schools are a threat to students, facility, and employees and cause an increase in recovery activities following an earthquake.

**OBJECTIVE:** Reduce the impact of non-structural events following an earthquake

**ACTION:** Develop and implement a manual similar to Salt Lake City school districts.

Category	Property Protection and Emergency Services
Time Frame	Immediate
Funding Source	School Districts, State Earthquake Program Grant
Responsibility	School Districts, County Emergency Management
Estimated Cost	Minimal if using SLC School District template
Background	Train and exercise local school districts on the non-structural methods identified in the document.
<b>Priority</b>	<b>HIGH</b>

**ACTION 2:** Develop a training document for schoolteachers showing non-structural mitigation activities for classrooms.

Category	Property Protection and Emergency Services
Time Frame	Ongoing
Funding	County Emergency Services, State Earthquake Program
Responsibility	County Emergency Services, School District
Estimated Cost	Minimal
Background	Show methods, techniques, and equipment and associated costs for non-structural mitigation in the classroom.
<b>Priority</b>	<b>HIGH</b>

**PROBLEM IDENTIFICATION:** Critical facilities (public safety, utilities, water/waster water/sewer, schools, hospitals), need to be made less vulnerable from the impacts of earthquakes to allow to a more timely and efficient response and recovery.

**OBJECTIVE:** Reduce the impact of non-structural events following an earthquake.

**ACTION:** Develop an earthquake vulnerability study for identified critical facilities.

Category	Emergency Services
Time Frame	Ongoing

Funding	County Emergency Services, (FEMA Grants)
Responsibility	County Emergency Services and other County/City Agencies
Estimated Cost	Unknown and dependent on scope of project.
Background	Identify critical infrastructure and rank accordingly to assist in upgrades to facilities.
<b>Priority</b>	<b>HIGH</b>

**PROBLEM IDENTIFICATION:** Areas of high liquefaction (western Weber county: Hooper, Far West, West Warren, West Haven, Marriott-Slaterville, Plain City) are experiencing increased growth.

**OBJECTIVE:** Increased awareness of high liquefaction areas

**ACTION:** Include current liquefaction maps on the County website.

Category	Emergency Services, Public Information and Prevention
Time Frame	Within the year
Funding	County Emergency Services and County Engineer
Responsibility	County Emergency Services, County Engineer, GIS and Web
Estimated Cost	Minimal.
Background	Public information on hazard and risk.
<b>Priority</b>	<b>HIGH</b>

**PROBLEM IDENTIFICATION:** Development on identified fault traces increase the risk to life and property.

**OBJECTIVE:** Promote natural hazards ordinance limiting development in high-risk areas.

**ACTION:** Make available copy of county natural hazards ordinance for cities within the county.

Category	Prevention
Time Frame	Within the year
Funding	County Emergency Services and County Engineer
Responsibility	County Emergency Services and County Engineer

Estimated Cost	Minimal.
Background	Weber County has a Natural Hazard Ordinance to address development in high-risk areas. Cities within the County should be made aware of this Ordinance and hopefully implement the same regulatory ordinance in their community.
<b>Priority</b>	<b>HIGH</b>

## **HAZARD: FLOOD**

**PROBLEM IDENTIFICATION:** Communities not involved in the NFIP.

**OBJECTIVE:** Have federal flood insurance available within communities and adopt flood loss prevention ordinances.

**ACTION:** Encourage the communities of Washington terrace and Huntsville to participate in the NFIP.

Category	Prevention
Time Frame	Ongoing
Funding	None required
Responsibility	State Floodplain Manager, City Officials, Building Officials
Estimated Cost	None
Background	This will make FEMA review and identify flood hazards in the area and will allow for a more accurate flood risk assessment. It will also allow citizens to buy federal flood insurance.
<b>Priority</b>	<b>MEDIUM</b>

**PROBLEM IDENTIFICATION:** Stormwater issues continue to be a critical flood issue in the county.

**OBJECTIVE:** Implement and fund identified stormwater projects to lessen impact of flooding in the county.

**ACTION:** Include current stormwater plans and projects in hazard mitigation plan.

Category	Prevention
Time Frame	Ongoing
Funding	Project specific, funding from County, Stormwater, State and Federal Programs.

Responsibility	County Stormwater, County Engineer
Estimated Cost	Depending on project.
Background	Weber County's Stormwater Program is actively involved and promotes sound land use planning and flood loss reduction activities. The long-term plan and identified projects will help alleviate flooding in the County and Cities within County. The County Master Plan has identified areas of concern and the "Regional Storm Water Management Plan" has addressed those areas with a detailed list of projects.
Priority	<b>MEDIUM</b>

**PROBLEM IDENTIFICATION:** Weber County has an extensive canal system and canal breach or overtopping has and will continue to create a significant flood threat.

**MITIGATION OBJECTIVE:** Evaluate canals in the county that may cause flooding.

**ACTION:** Identify canals in the county that have the potential to cause damage due to flooding.

Category	Emergency Services
Time Frame	Two years
Funding	County Emergency Management, State Mitigation Program Grant
Responsibility	County Stormwater, County Engineer, County Emergency Services, State Hazard Mitigation Planner
Estimated Cost	Depends on scope of study
Background	City of Riverdale experienced a significant flood event from a canal breach. Other private canals may also be of concerns.
Priority	<b>LOW</b>

#### **HAZARD: SEVERE WEATHER**

**PROBLEM IDENTIFICATION:** Most disaster declarations are generated from weather related incidents. Weber County continues to be impacted by snowstorms, hail, thunderstorms/lightning, tornados, heavy rain, and avalanche.

**MITIGATION OBJECTIVE:** Reduce impact to life and property from severe weather related incidents

**ACTION:** Establish and support countywide National Weather Service Storm Ready program.

Category	Public Information
Time Frame	Two years
Funding	County Emergency Management
Responsibility	County Emergency Management, SLC NWS
Estimated Cost	Minimal, some cost for weather radios
Background	This is a proactive public information program that allows communities to be recognized for many weather related activities they are already doing.
Priority	<b>MEDIUM</b>

**ACTION 2:** Identify areas of avalanche risk and develop and post signs for avalanche danger

Category	Public Information
Time Frame	Ongoing
Funding	County Emergency Management, County and City Planners, County and City Engineers, Road Dept/Public Works
Responsibility	County/City Engineers and Road Dept./Public Works
Estimated Cost	Minimal, for signs and placement of signs.
Background	Avalanche danger in areas of North Ogden Divide and in the Ogden Valley will continue to threaten lives and property as people move and travel into areas of risk.
Priority	<b>LOW</b>

#### **HAZARD: WILDLAND FIRE**

**PROBLEM IDENTIFICATION:** Urban interface wildland fire continues to be of concern in areas of Uintah Highlands, Wolf Creek, North Ogden, and other areas of the Ogden Valley.

**MITIGATION OBJECTIVE:** Reduce impact to life and property from urban interface wildland areas

**ACTION:** Develop and implement a strong land use ordinance that addresses fuel reduction in areas at risk from fire.

Category	Prevention
Time Frame	Ongoing
Funding	County/City Emergency Management, Planning and Zoning, County and City Attorneys, Public Officials
Responsibility	County/City Emergency Management, Planning and Zoning, County and City Attorneys, Public Officials
Estimated Cost	Minimal - Time and involvement.
Background	Weber County and cities within the County continue to struggle with existing wildland fire interface communities such as Uintah Highlands. It is critical new developments in areas of risk are designed to lessen the impact from such fires.
Priority	<b>HIGH</b>

**ACTION 2:** Have communities participate in the Fire Wise Community programs.

Category	Property Protection
Time Frame	Ongoing
Funding	Forestry Fire and State Lands, US Forest Service
Responsibility	Contractors, County and City Fire, Local participation
Estimated Cost	Minimal - Time and involvement.
Background	Weber County and cities within the County continue to struggle with existing wildland fire interface communities such as Uintah Highlands. It is critical new developments in areas of risk are designed to lessen the impact from such fires.
Priority	<b>HIGH</b>

#### **HAZARD: DAM FAILURE**

**PROBLEM IDENTIFICATION:** Dam failure from federal, state and private dams can impact Weber County. Debris basin type dams are of concern at Birch Creek, Glassman Way, and on Harrison Blvd.

**MITIGATION OBJECTIVE:** Reduce the impact of catastrophic flooding due to dam failure

**ACTION:** Re-evaluate current high hazard dams and evaluate use of early warning sirens to warn public.

Category	Emergency Services
Time Frame	Ongoing
Funding Source:	Local and State
Responsibility:	County Emergency management
Estimated Cost	Unknown
Background	A catastrophic dam failure can impact a significant population in the County. Evaluating the risk and vulnerability will allow for a more efficient emergency response.
Priority	<b>MEDIUM</b>

**ACTION 2:** Identify and then fund dams needing armored concrete chutes.

Category	Prevention
----------	------------

Time Frame	Unknown and based on funding
Funding Source:	Local and State
Responsibility:	Stormwater Management, County Engineer, State Engineer
Estimated Cost	Unknown
Background	A catastrophic dam failure can impact a significant population in the County. Armored concrete chutes are an approved structural mitigation measure.
<b>Priority</b>	<b>MEDIUM</b>

### **HAZARD: LANDSLIDES**

**PROBLEM IDENTIFICATION:** Weber County has significant areas of landslides.

**OBJECTIVE:** Re-evaluate current landslide map

**ACTION:** Update current landslide map and supporting data

Category	Prevention
Time Frame	Unknown and based on funding
Funding Source:	Local and State
Responsibility:	County and City Engineering
Estimated Cost	Unknown
Background	Current landslide maps include data that does not necessarily reflect areas at risk.
<b>Priority</b>	<b>LOW</b>

**MITIGATION OBJECTIVE:** Monitor landslide movement in areas that impact infrastructure and population.

**ACTION:** Evaluate landslide areas where parameters can be used

Category	Property Protection
Time Frame	Unknown and based on funding
Funding Source:	Local and State

Responsibility:	County and City Engineering, UGS
Estimated Cost	Unknown
Background	Area of Bear Hollow and the mouth of Weber Canyon have active landslides and can impact roads and population.
Priority	<b>LOW</b>

**Weber County - Risk Assessment Summary  
(From Weber County EOP – February 2000)**

	<u>Consequences / Impact of an Event</u>		
<b>Probability of an Event</b>	<b><u>Severe</u></b>	<b><u>Moderate</u></b>	<b><u>Limited</u></b>
<b><u>High</u></b>	Earthquake  <i>High Risk</i>	Wildland/Urban Fire  <i>High Risk</i>	Tornado Storm Flooding Small Hazmat Spill  <i>Moderate Risk</i>
<b><u>Moderate</u></b>	Large Hazmat Spill  <i>High Risk</i>	Drought Mudslide  <i>Moderate Risk</i>	Strong Wind Micro-burst Ground Transportation-Accident Winter Storm Event <i>Low Risk</i>
<b><u>Low</u></b>	Nuclear Attack Dam Break Air Transportation-Accident  <i>Moderate Risk</i>	Civil Unrest  <i>Low Risk</i>	Extreme Heat Lightning Avalanche Landslide Canal Break Explosive Devices  <i>Low Risk</i>

**Risk Assessment Methodology – Weber County EOP – February 2000**

A complete hazard analysis should identify the range of possible risks that might impact a jurisdiction and/or the surrounding area. The emergency response system and the jurisdiction should be prepared to manage disasters from the least to most serious within the identified range.

The hazard identification and risk assessment should identify what can occur, when, or how often it is likely to occur (also referred to as frequency or probability of occurrence), and how bad the effects could be (impact or consequences). For some of the hazards identified, it will not be necessary to carry out a full analysis. These are hazards for which no further action is required. For some hazards, inclusion in a mitigation planning section will be required. Development of a specific annex for response and recovery efforts may also be required depending on the hazard and the specific risks it brings to the county or specific operational considerations. In short, based upon this hazard analysis, some hazards will require nothing more than the identification of their existence, while some hazards will require specific planning efforts for response, recovery, mitigation, and preparedness. All of this is based upon risk.

Risk is the combination of probability/frequency and impact/consequences. A hazard with a high probability and high impact on the community would naturally be categorized as a High Risk hazard. Conversely, a hazard with a low probability and low impact on the community would naturally be categorized as a Low Risk hazard. The matrix that follows is an attempt to graphically present the definitions used in the hazard analysis into a single risk code. Hazard risk priorities of High, Medium and Low are indicated for each hazard.

The matrix is comprised of a vertical axis, which categorizes the probability or frequency of a hazard creating an incident, and a horizontal axis, which categorizes the impact or consequences of a hazard. In an effort to more clearly define the probabilities and consequences associated with hazards in our county, definitions of impact and probability are given here.

Impact is defined as the effect of a hazard on the community, or the consequences of an event on a community. For this analysis, both impact and consequences are being used synonymously.

Each hazard has been defined as having a Limited, Moderate or Severe impact or consequence upon the community. The consequences have been categorized based upon the impact or consequences of the hazard in each of six impact areas. These six areas are: Public Health, Responder Safety, Property, Facilities/Infrastructure, Environment, and Economical/Financial.

Limited, Moderate and Severe impact levels have been defined as follows:

**Limited Impact** - Any hazard with a limited impact designation may have consequences upon the community as defined within the six major impact areas in the following manner:

1. Public Health -  
Treatable injuries through first aid. Loss of quality of life.
2. Responder Safety-  
No significant threat to responder safety. Treatable first aid injuries if any.
3. Property-  
Only properties located in close proximity to the hazard/incident are affected. No more than 5% of the property located nearby is severely damaged.
4. Facilities / Infrastructure-  
Complete shutdown of facilities and critical services for less than 24 hours. May only be in isolated areas of community.
5. Environment-  
Release into the environment such that there is no measurable impact to the environment. High amount of the release is contained, very little damage to water or air. Very low threat to health, safety, or the environment based upon type of release, quantity, and location. Meets threshold of reportable quantities reporting requirements.
6. Economic / Financial-  
Minor loss to financial base. Non-incapacitating losses. Funding not available within first 12-24 hours to initiate recovery efforts.

Any hazard with the potential impact or consequences as defined above will be given the designation of Limited Impact.

**Moderate Impact** - Any hazard with a moderate impact designation may have consequences upon the community as defined within the six major impact areas in the following manner:

1. Public Health -  
Long-term minor quality of life loss. Major injuries, some deaths.
2. Responder Safety-  
Threat to responder safety. Treatable injuries that may require transport. Site Safety Plans required, implemented. After-action review.
3. Property-  
Properties located in close proximity to the hazard/incident are affected. Other property located nearby is also slightly affected. No more than 20% of the property located in close proximity is severely damaged.
4. Facilities / Infrastructure-  
Complete shutdown of facilities / critical services for 24-48 hours. May be community wide effect.
5. Environment-  
Release into the environment such that there is a measurable impact to the environment. Release not necessarily contained, threatens water and/or air, will require detailed remediation (short-term process). Definite threat to health, safety, and/or the environment based upon type of release, quantity, and location. Requires protective actions for population.

6. Economic / Financial-

Loss to financial base. Some incapacitating losses. Funding not available within first 24-36 hours to initiate recovery efforts.

Any hazard with the potential impact or consequences as defined above will be given the designation of Moderate Impact. Moderate Impact events, or hazards with the potential for moderate impact on the community will be evaluated upon the six criteria or descriptions of impact listed above.

**Severe Impact Definitions-** Any hazard with a limited impact designation may have consequences upon the community as defined within the six major impact areas in the following manner:

1. Public Health -

Long-term quality of life loss. Major injuries, numerous deaths.

2. Responder Safety-

Major concerns for responder safety. Treatable injuries that require transport. Site Safety Plans required, implemented. After-action review. Extraordinary precautions.

3. Property-

Property located throughout the community is affected. Impact on property regardless of location. However, no less than 20% of the property located in close proximity to the incident is severely damaged.

4. Facilities / Infrastructure-

Complete shutdown of facilities / critical services for more than 48 hours.

5. Environment-

Release into the environment such that there is a substantial impact to the environment. Much of the release may not be contained, threatens water and/or air, will require extensive remediation (long-term process). Serious threat to health, safety, and/or the environment based upon type of release, quantity, and location. Requires protective actions for population with long-term consequences.

6. Economic / Financial-

Major loss to financial base. Incapacitating losses. Funding not available within first 36-48 hours to initiate recovery efforts.

Any hazard with the potential impact or consequences as defined above will be given the designation of High Impact. Each hazard in the County must be categorized by its impact on the community. Once impact, or consequences are understood for each hazard, it is equally important to understand probability, or frequency ratings.

Hazard probability is the likelihood that an identified hazard will result in an incident. Hazard probability or frequency has been used to help understand the overall risk to a community. For planning and analysis purposes, the probability ratings of High, Moderate/ Medium, and Low have been used for our model. These probability, or frequency ratings, make the potential impacts clearer to decision makers. These three ratings have been given the following definitions:

**High =** 1) A hazard whose potential impact is very probable at anytime during the next 12 months, 2) A hazard that occurs frequently based upon historical data, 3) A hazard that occurs infrequently yet is beyond its time line of expectancy for the next occurrence, 4) A hazard with an 80 - 99% probability of occurrence.

**Moderate =** 1) A hazard whose potential impact is very probable at anytime during the next 12

to 36 months, 2) A hazard that occurs occasionally based upon historical data, 3) A hazard that occurs infrequently but is nearing its time line of expectancy for the next occurrence, 4) A hazard with more than a 50% probability of occurrence.

**Low =** 1) A hazard whose potential impact is not very probable at anytime during the next 36 months, 2) A hazard that does not occur frequently based upon historical data, 3) A hazard that is not near or beyond its time line of expectancy for the next occurrence, 4) A hazard with less than a 50% probability of occurrence.

The definitions given have multiple examples, or denotations, to assist in the overall understanding of each probability, or frequency rating.

The Risk Assessment Matrix is as follows:

### **Risk Assessment Matrix**

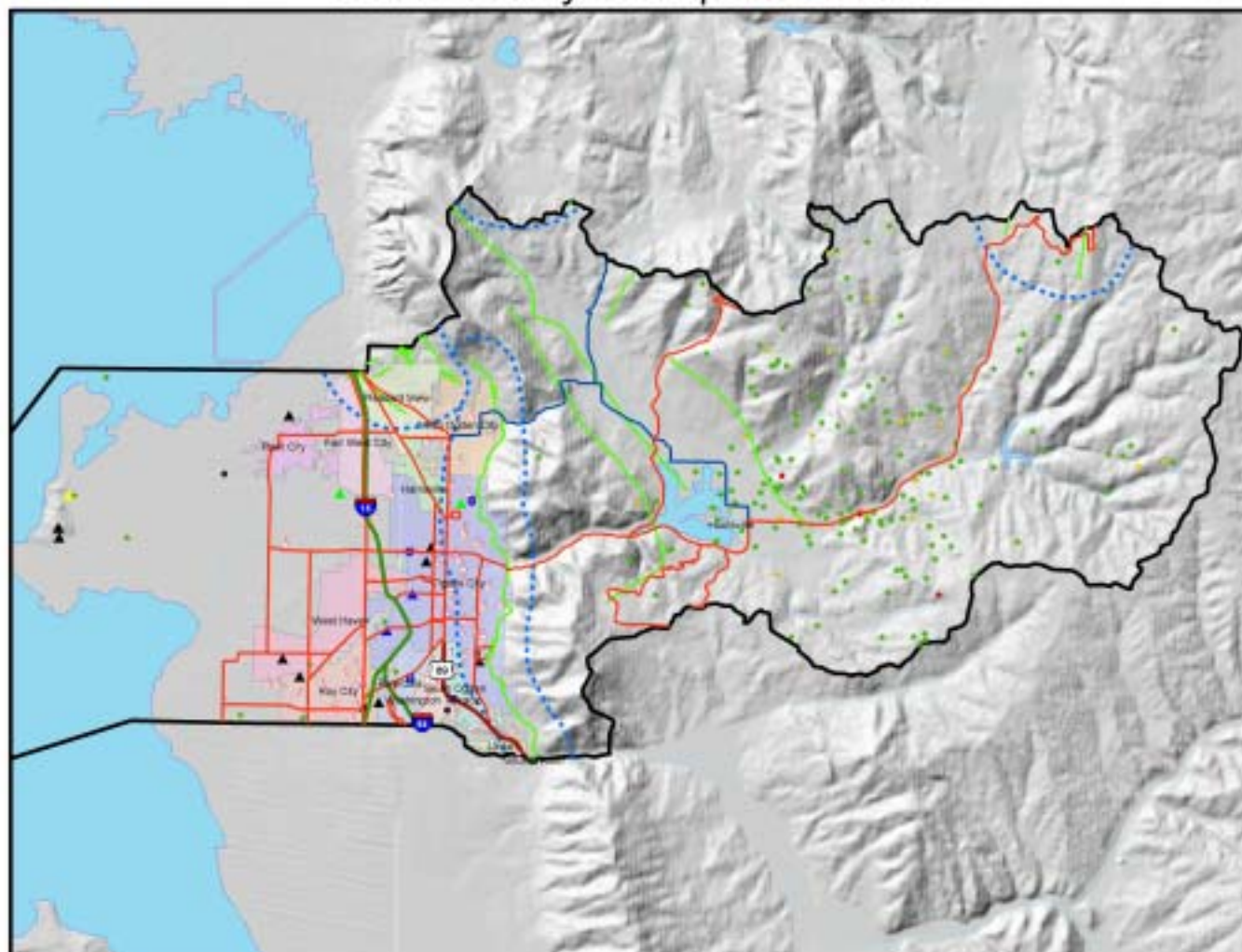
	<u><b>Consequences / Impact of an Event</b></u>		
<u><b>Probability of an Event</b></u>	<b>Severe</b>	<b>Moderate</b>	<b>Limited</b>
<b>High</b>	High Probability Severe Consequences  <i><b>High Risk</b></i>	High Probability Moderate Consequences  <i><b>High Risk</b></i>	High Probability Limited Consequences  <i><b>Moderate Risk</b></i>
<b>Moderate</b>	Moderate Probability Severe Consequences  <i><b>High Risk</b></i>	Moderate Probability Moderate Consequences  <i><b>Moderate Risk</b></i>	Moderate Probability Limited Consequences  <i><b>Low Risk</b></i>
<b>Low</b>	Low Probability Severe Consequences  <i><b>Moderate Risk</b></i>	Low Probability Moderate Consequences  <i><b>Low Risk</b></i>	Low Probability Limited Consequences  <i><b>Low Risk</b></i>

## **H. Maps**

All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 11.1.1 Weber County Earthquake Threat  
 Map 11.1.2 Weber County Liquefaction Potential  
 Map 11.2.1 Weber County Wildfire Risk  
 Map 11.4.1 Weber County Landslide Hazard  
 Map 11.5.1 Weber County Dam Hazard

## Weber County Earthquake Hazard



- Fault zones
- Faults
- Magnitude**
  - 1-2
  - 2-3
  - 3-4
- Fire Station
- Police Station
- ▲ School
- Care Facility
- Waste Water Facility
- Potable Water Facility
- ▲ Oil Facility
- Electric Power Facility
- ▲ Communication Facility



0 2.5 5 10  
Miles

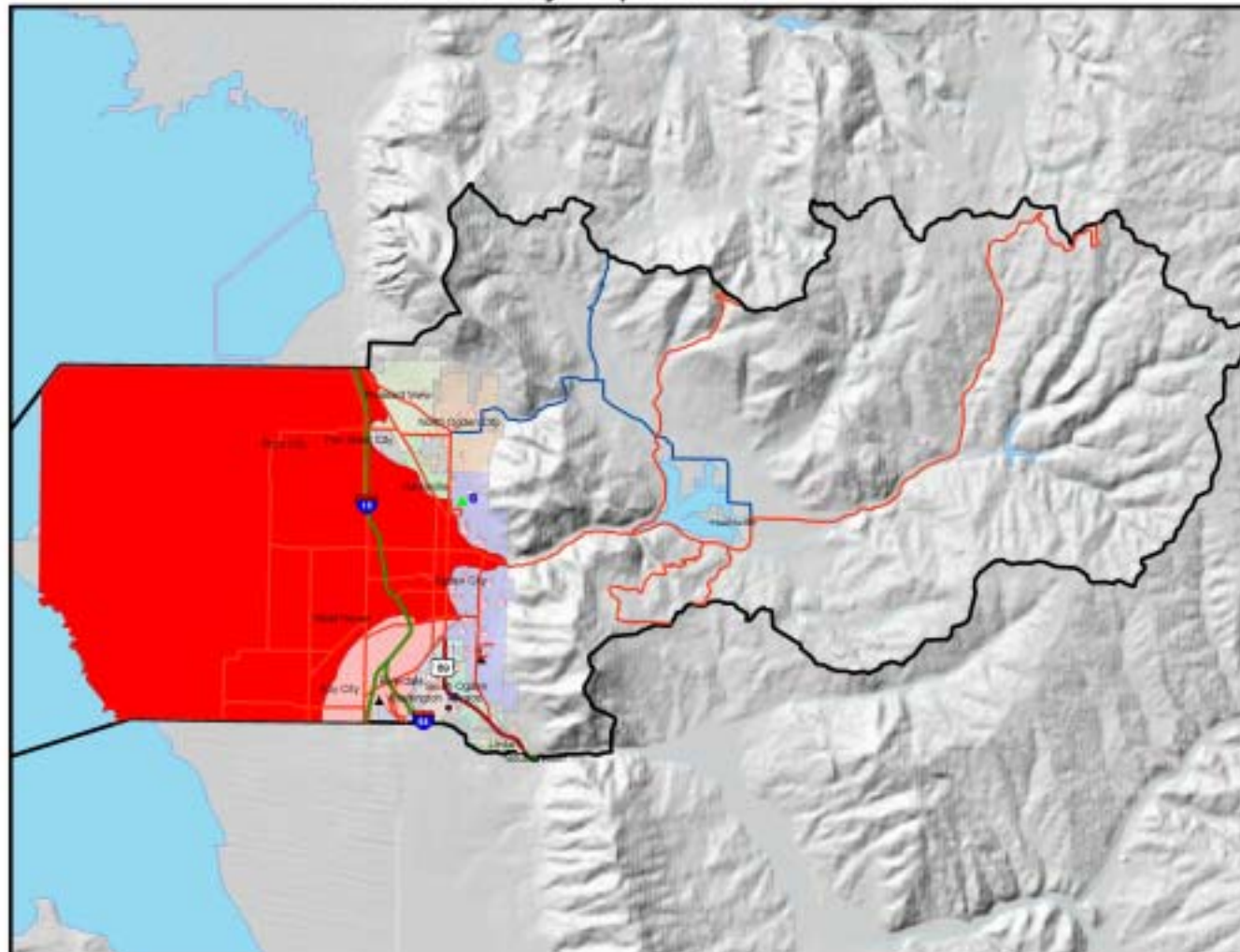
Wasatch Front Regional Council



Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties which accompany this product.

## Weber County Liquefaction Potential



### Liquefaction

- Moderate
- High
- Fire Station
- Police Station
- School
- Care Facility
- Waste Water Facility
- Potable Water Facility
- Oil Facility
- Electric Power Facility
- Communication Facility



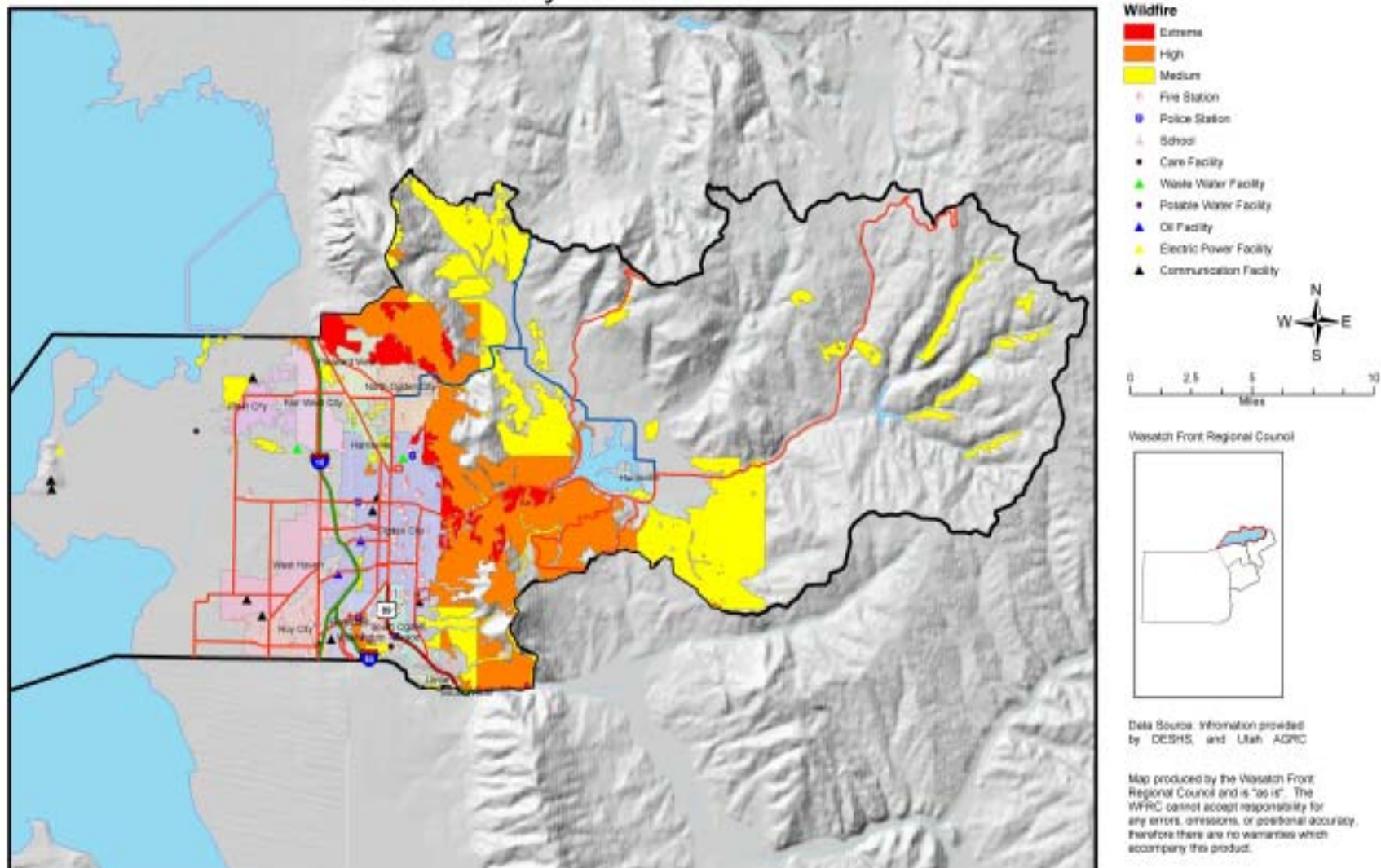
### Wasatch Front Regional Council



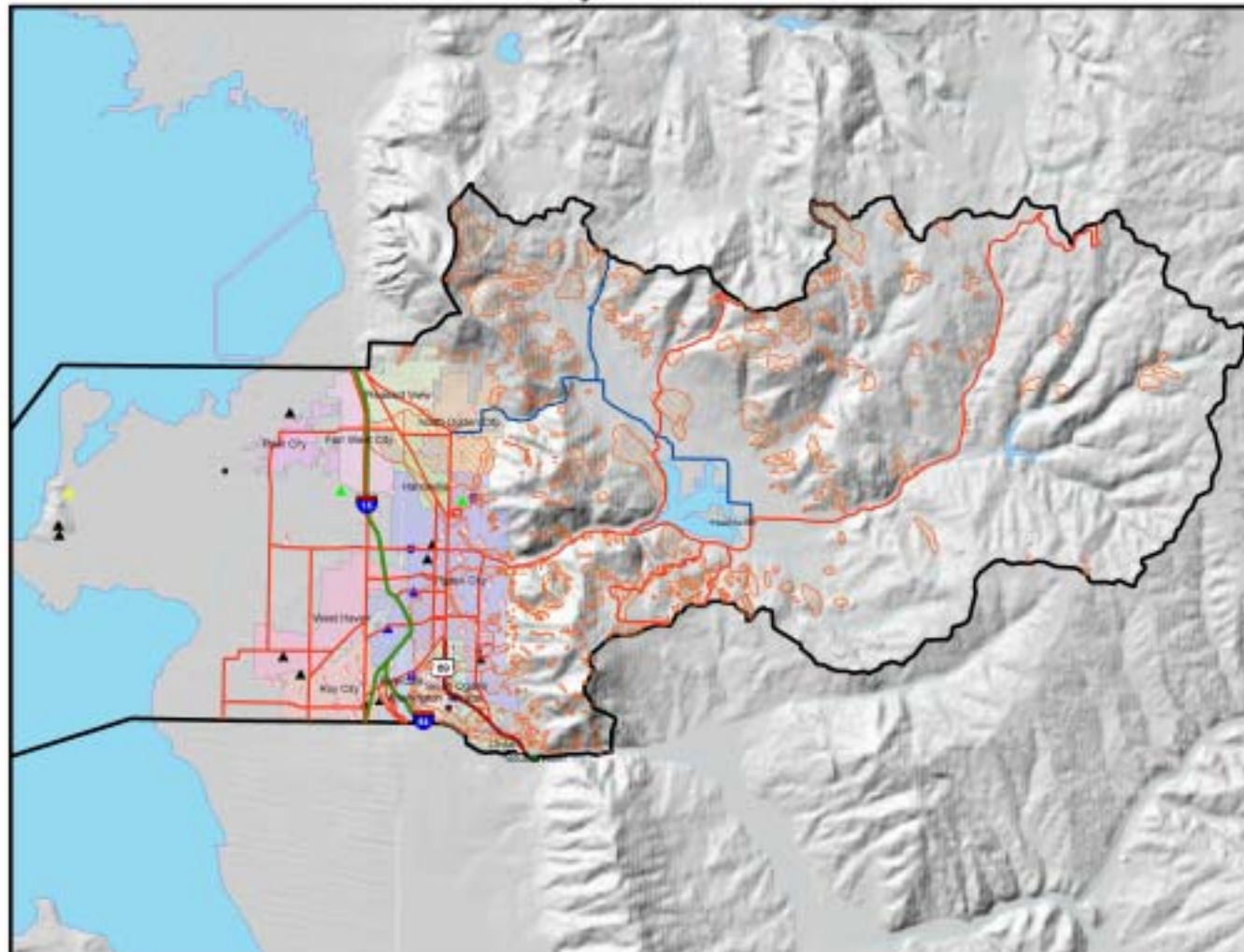
Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRG cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties which accompany this product.

## Weber County Wildfire Risk



## Weber County Landslide Hazard



- Landslides
- Fire Station
- Police Station
- School
- Care Facility
- Waste Water Facility
- Potable Water Facility
- Oil Facility
- Electric Power Facility
- Communication Facility



0 2.5 5 10  
Miles

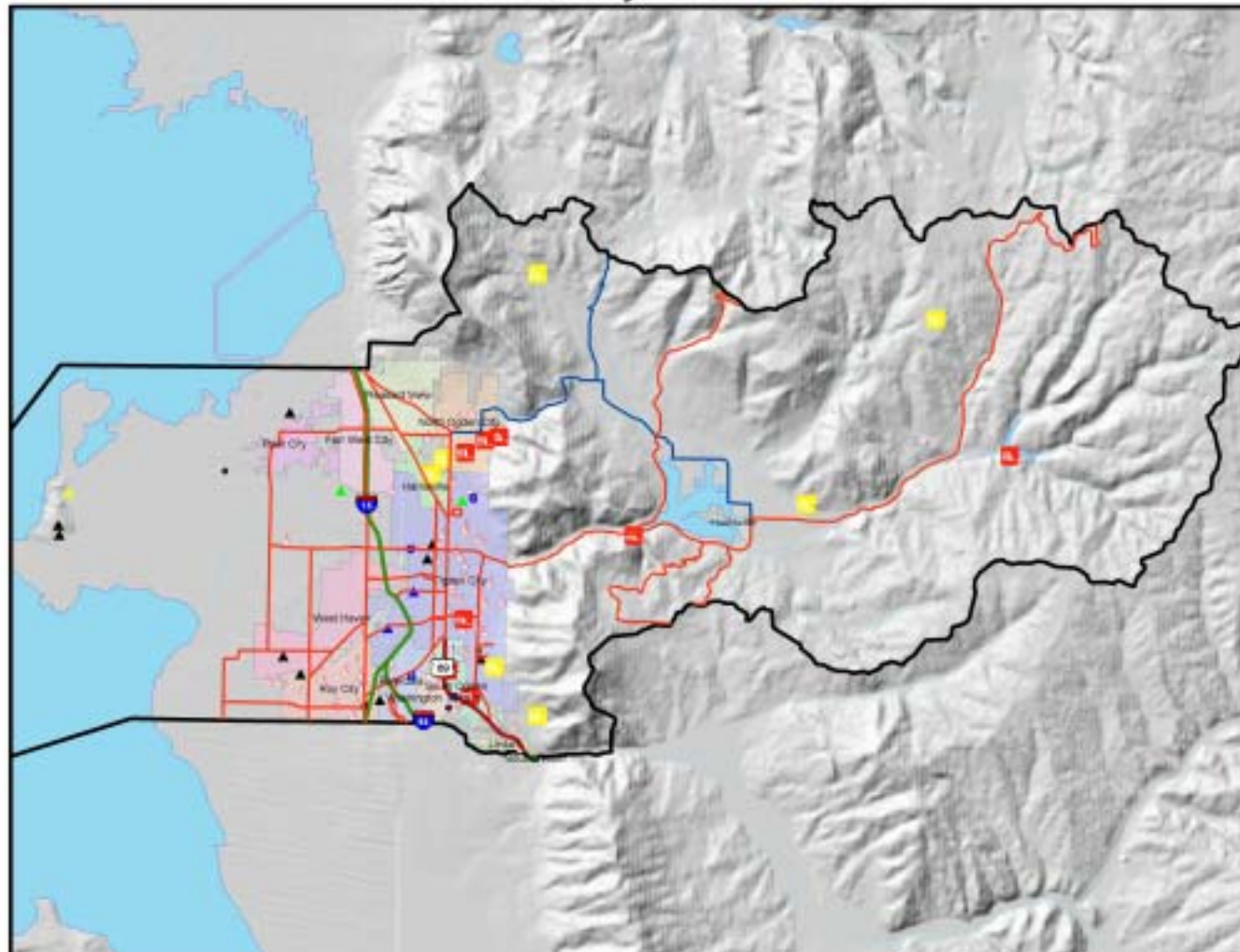
Wasatch Front Regional Council



Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRG cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties which accompany this product.

## Weber County Dam Hazard



### Dam Hazard

- HIGH - Possible loss of life
- MODERATE - Significant property loss
- LOW - Insignificant property loss
- Fire Station
- Police Station
- ▲ School
- Care Facility
- ▲ Waste Water Facility
- Potable Water Facility
- ▲ Oil Facility
- ▲ Electric Power Facility
- ▲ Communication Facility



### Wasatch Front Regional Council



Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRG cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties which accompany this product.

## Part XII. Regional Hazards

Due to the geographic extent these hazards have not been mapped and risk assessments were unable to be compiled. Therefore all of the information for the following regional hazards is in the narrative below. The entire region is subject to these hazards with no unique risk affecting a single jurisdiction. Refer to each county section for a list of historical hazard events.

Severe weather includes High Winds, Severe Storms (Thunderstorms, Lightning, Hailstorms, Heavy Snow or Rain, Extreme Cold), Tornado, and Avalanche.

### 1. Severe Weather

#### Hazard Profile

Potential Magnitude	X	Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	Occur in very localized areas throughout the region, unable to identify exactly when and where the next event will take place.		
Seasonal Pattern or Conditions	Based on climate, elevation, and precipitation.		
Duration	Severe Weather hazards generally last hours and can last days.		
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, Utah DESHS, local input, and review of historic events and scientific records.		

#### High Winds

High winds can occur with or without the presence of another storm and are determined to be unpredictable in regards to time and place. Each of the five counties that make up the Wasatch Front has experienced high winds in the past, generally during the spring and summer months. These counties can expect regional high wind events in the future.

Canyon winds can bring wind gusts of more than 100 mph through the canyon mouths into the populated areas of the Wasatch Front. Winds are usually strongest near the mouths of canyons and have resulted in the loss of power and the inability to heat homes and businesses. Winds in the past have damaged roofs, destroyed and knocked down large trees and fences, overturned tractor -trailers, railroad cars, and small airplanes.

#### Severe Storm

Severe storms can include thunderstorms, hailstorms, heavy snow or rain, and extreme cold. They are generally related to high precipitation events during the summer and winter months. Severe storms can happen anywhere in the region and the damage can be extensive especially for agriculture, farming, and transportation systems. They can also disrupt business due to power outages.

#### Thunderstorms

A thunderstorm is a storm made up of heavy rain or hail along with thunder and lightning resulting from strong rising air currents. Based on historical evidence thunderstorms can strike anywhere in the region mainly during the spring and summer months

**Lightning**

Lightning is the electric discharge accompanied by light between clouds or from a cloud to the earth. In Utah, lightning is the number one natural hazard killer. Lightning can also start wildland fires, which could be potentially fatal or disruptive.

**Hailstorms**

Hailstorms occur when freezing water in thunderstorm type clouds accumulates in layers around an icy core generally during the warmer months of May through September. Hail causes damage by battering crops, structures, and automobiles. When hailstorms are large (especially when combined with high winds), damage can be extensive. The risk of hailstorms is not targeted to any particular areas within the region.

**Heavy Snow or Rainfall**

Heavy amounts of precipitation from rain or snow can result in flash flood events. Historically, The Wasatch Front has been susceptible to these types of storms because of close proximity to the mountain ranges. Major winter storms can produce five to ten times the amount of snow in the mountains than in the valley locations.

Most of the valley's development occurs on old alluvial fans from the canyon mouths. During heavy precipitation flood waters and debris will occur on these same alluvial fans, damaging residential and commercial property along with infrastructure. The associated threat with heavy snowfall is avalanches.

**Extreme Cold**

Sub-zero temperatures occur in the Wasatch Front during most winters, however prolonged periods of extremely cold weather are infrequent. January is generally the coldest month of the year. Historically extreme cold in the region has disrupted agriculture, farming, and crops. Extreme cold also affects life, especially vulnerable are the young and elderly and animals.

Valley temperature inversions occur during the winter months and keep cold, foggy, moist air trapped to the Wasatch Front valley floor. This is a result of the high pressure trapping the air in the valley. The fog and smog can cause serious visibility restrictions and icy surfaces as well as health alerts. High winds are needed to clear the inversion.

**Avalanche**

Avalanches occur on steep slopes and therefore the mountainous areas as well as the foothills around the region are all vulnerable. Even though most avalanches occur on forested lands they affect mostly city and county dwellers. Therefore, avalanches should be given a priority in Utah due the number of historical occurrences. The money spent to respond, and recover from an avalanche in addition to the man-hours and property affected by a slide is usually on or given by the city and/ or county.

The probability of a future event is likely dependant on the amount of heavy snowfall during a given year. Most deadly avalanches occur in the backcountry away from developed areas. Avalanche control is performed regularly in developed ski areas to minimize the threat and increase awareness. The Avalanche Center was initiated as another resource for measuring risk and increasing awareness to the residents of the Wasatch Front region.

**Tornado**

Historically, atmospheric conditions have not been favorable for the development of tornadoes in Utah due to the dry climate and mountainous terrain. Utah averages about two tornados per year. Utah tornados are usually no more than 60 feet wide at the base and last up to 15 seconds. Tornadoes occur during the months of May, June, July, and August usually preceding a cold front. Utah is one of the lowest ranked nations for incidences of tornadoes with only one F2 or stronger tornado every seven years.



\*On October 18, 1984, a "lake effect" snowstorm dropped 22 inches of snow in 24 hours on the east benches of the Salt Lake Valley. The man in this photo is Paul R. Rich of Holladay. (Photo by of the Salt Lake Tribune.) Source: [http://www.utahweather.org/UWC/weather\\_pictures/weather\\_photos\\_1900-2002.html](http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html).

\*At about 7:00 PM on January 10, 1964, forty mile-per-hour winds caused newly fallen snow to roll up like a lady's hand muff, creating an army of "snow rollers" that marched through Sugarhouse Park in Salt Lake City. (Photo by L. V. McNeely). Source: [http://www.utahweather.org/UWC/weather\\_pictures/weather\\_photos\\_1900-2002.html](http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html).



\*At about 3:00 AM, on August 12, 1985, a large lightning strike hit the southwestern part of the Salt Lake Valley. This picture was taken from Blue Fox Circle (at 6075 South and 3686 West) in Kearns. (Photo by Mike Rogers). Source: [http://www.utahweather.org/UWC/weather\\_pictures/weather\\_photos\\_1900-2002.html](http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html).

## 2. Drought

### Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Countywide		
Seasonal Pattern or Conditions	Summer		
Duration	Months, Years		
Analysis Used	National Weather Service, Utah Climate Center, National Geophysical Data center- Natural Hazards Database, Newspapers, Local input.		

Drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. The entire region is currently experiencing a drought from 1999- present. Drought dramatically affects this area because of the lack of water for agriculture and industry, which limits economic activity, irrigation and culinary uses. The severity of the drought results in depletion of agriculture lands and deterioration of soils. In the Wasatch Front region the risk of drought is high.

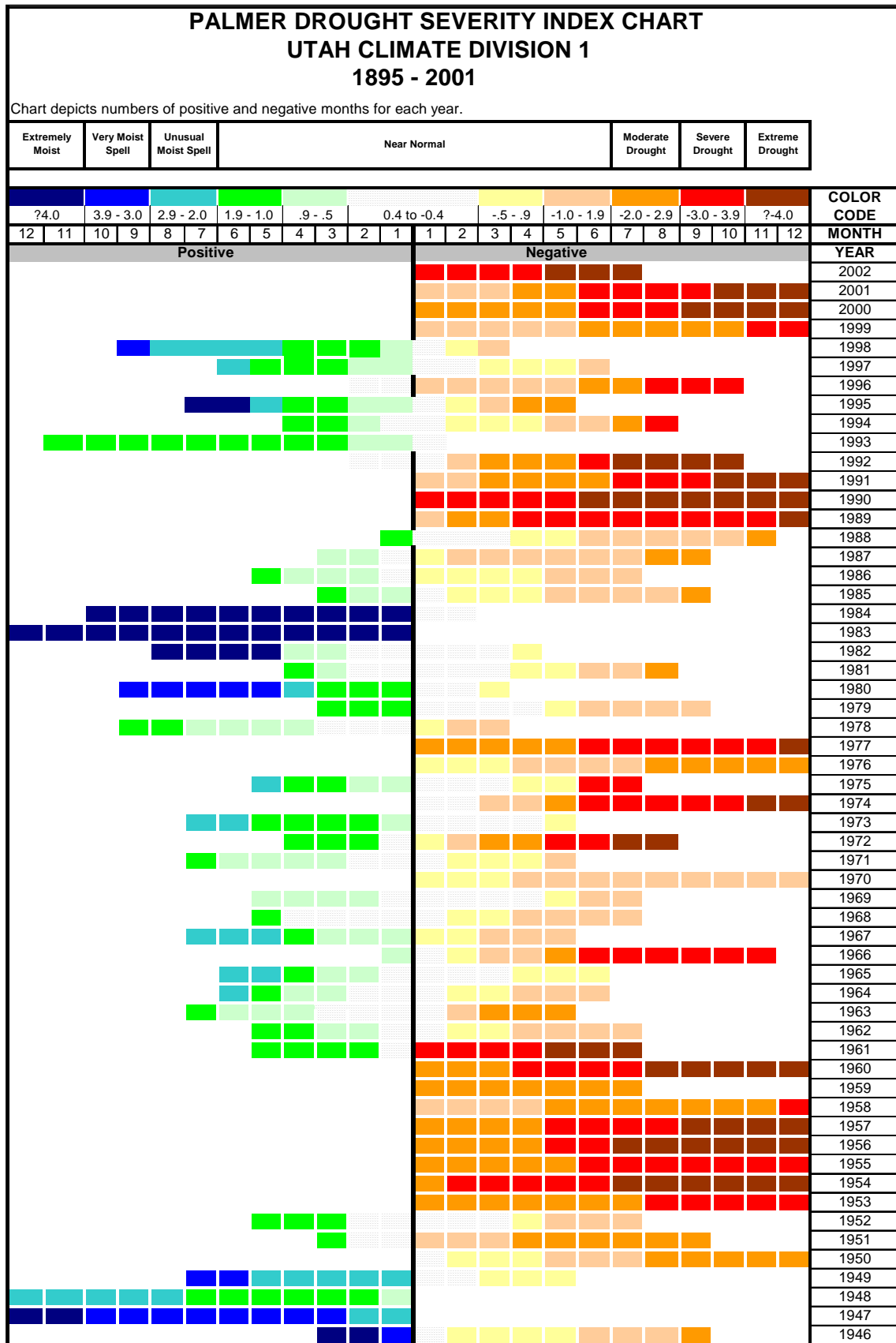
Drought is not targeted to any particular area within the region and the geographic extent of drought is hard to identify or map on a local or even county level. During the making of this plan, drought related GIS layers were unavailable to complete the mapping and analysis portions of the plan. Therefore, a vulnerability analysis including types and numbers of buildings, critical facilities, and infrastructure affected by drought were unable to be determined.

The secondary threats associated with drought include infestation and wildfire, all of which the region as historically been susceptible to. For a further explanation of infestation and wildfire refer to the Part VI Risk Assessment, Section E Hazard Description.

The Palmer Drought Severity Index developed by Wayne Palmer in the 1960's, measures drought severity using temperature and rainfall to determine dryness. The Palmer Drought Severity Index or (PDSI) has become the "semi-official" drought index as it is "standardized" to local climate and can be applied to any part of the country. The PDSI uses zero as normal and assigns a monthly numerical id between +6 and -6 with, server droughts having higher negative numbers. Thus, a moderate drought is minus 2, a sever drought minus 3, and extreme drought is minus 4. Excess rain is expressed using plus figures, with plus 2 representing moderate rainfall, etc. Refer to Figure 1 and 2.



Figure 1 Climate Division 1 Western



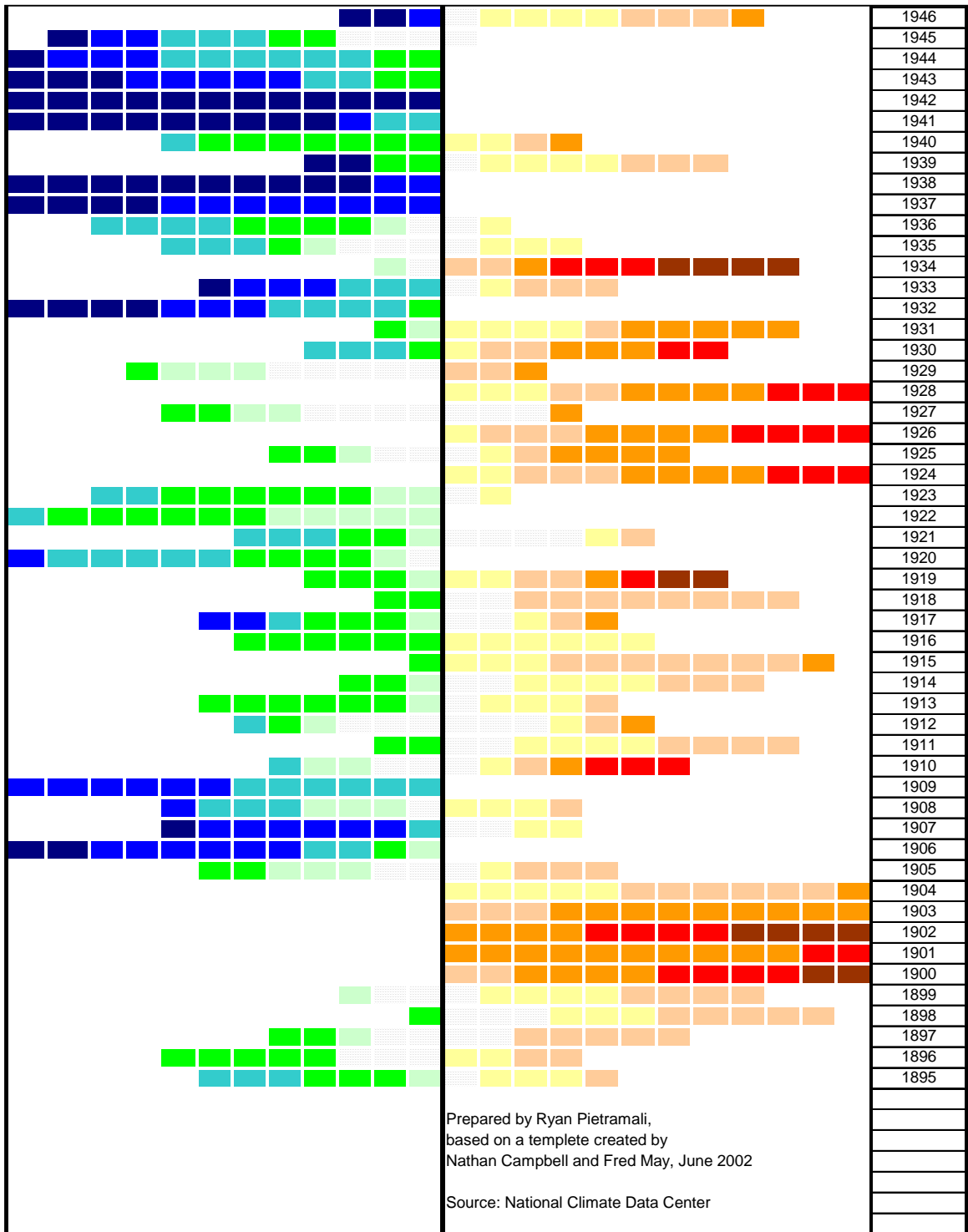
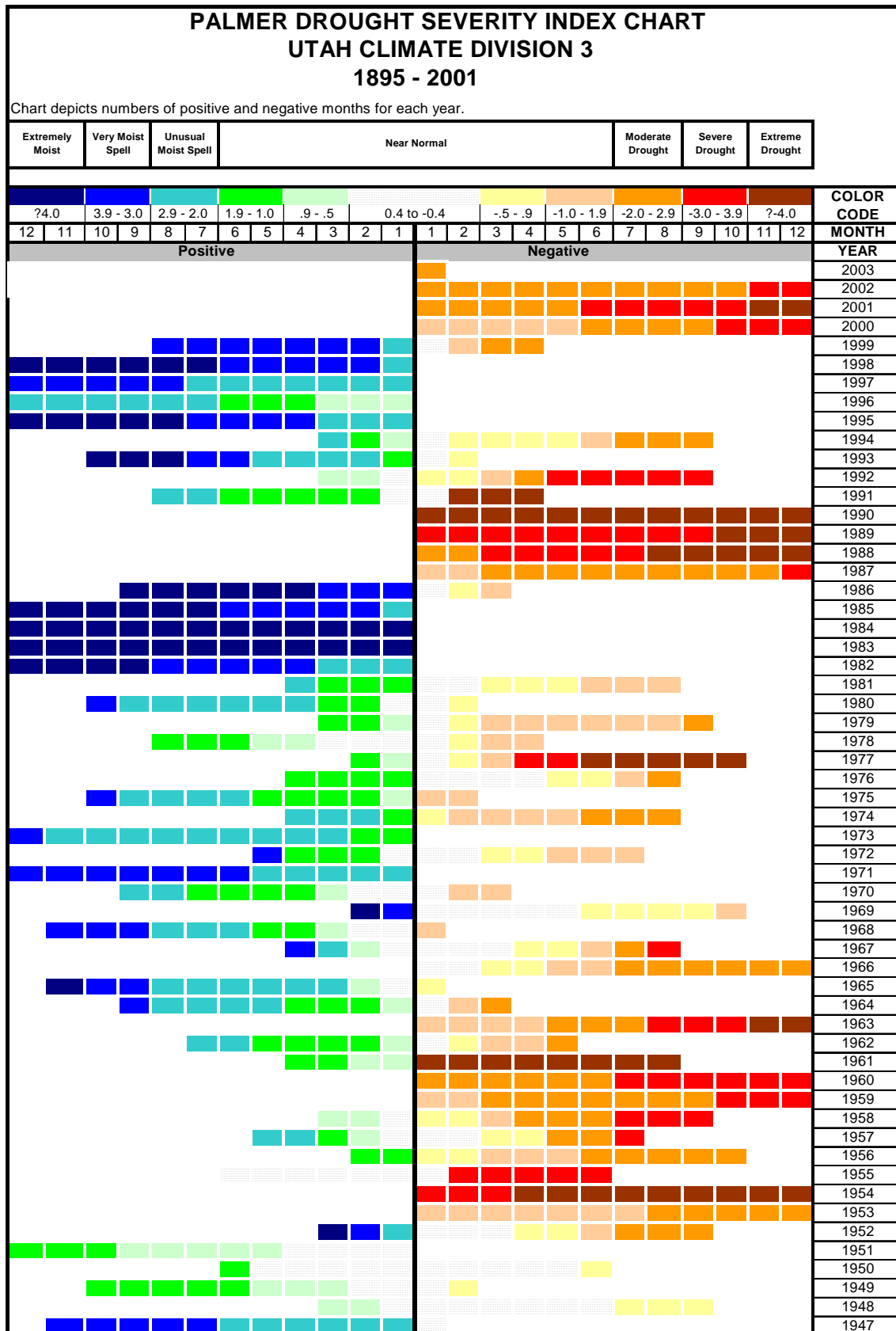


Figure 2 Climate Division 3 North Central





## **Part XIII. Maintenance and Implementation Procedures**

### **Monitoring, Evaluating and Updating the Plan**

Periodic monitoring and reporting of this plan is required to ensure that the goals and objectives for the region are kept current and that local mitigation efforts are being carried out. This plan has therefore been designed to be user-friendly in terms of monitoring and implementing.

#### Annual Reporting Procedures

This plan shall be reviewed annually, as required by the Utah DESHS, or as situations dictate such as following a disaster declaration. Each year the Wasatch Front Regional Council, Community Development Department will review the plan and ensure the following:

1. The Executive Director of the WFRC will receive an annual report and/or presentation on the implementation status of the plan.
2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the plan.
3. The report will recommend, as appropriate, any required changes or amendments to the plan.

If the WFRC Executive Director, participating Jurisdictions, or Utah DESHS determines that a modification of the plan is warranted, an amendment to the plan may be initiated.

#### Revisions and Updates

Periodic revisions and updates, based on funding, of the plan are required to ensure that the goals and objectives for the region are kept current. More importantly, revisions may be necessary to ensure the plan is in full compliance with Federal regulations and State statutes. This portion of the plan outlines the procedures for completing such revisions and updates.

#### Five (5) Year Plan Review

The entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the region that would affect the plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the plan.

The Natural Hazard Pre-Disaster Mitigation Planning Committees, with a potential membership representing every jurisdiction in the WFRC area, will be reconstituted for the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review will be summarized in the annual report prepared for this plan under the direction of the Community Development Director. The annual report will include an evaluation of the effectiveness and appropriateness of the plan, and will recommend, as appropriate, any required changes or amendments to the plan.

If the WFRC Executive Director, participating jurisdictions, or Utah DESHS determines that the recommendations warrant modification to the plan, an amendment may be initiated as described below.

### Plan Amendments

An amendment to the plan should be initiated by Utah DESHS, or the WFRC Executive Director, either at its own initiative or upon the recommendation of the State Hazard Mitigation Officer, Community Development Director or Mayor of an affected community.

Upon initiation of an amendment to the plan, WFRC will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full planning committee may be reconstituted or the WFRC Regional Growth Committee may review the amendment. At a minimum, the information will be made available through public notice in a newspaper of general circulation or on the WFRC website at [www.wfrc.org](http://www.wfrc.org).

Information will also be forwarded to the Utah DESHS. This information will be sent out in order to seek input on the proposed plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Community Development Director for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Community Development Director will review the proposed amendment along with comments received from other parties and submit a recommendation to the Executive Director within sixty (60) days.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the plan; and/or
2. New issues or needs have been identified which were not adequately addressed in the plan; and/or
3. There has been a change in information, data or assumptions from those on which the plan was based.
4. The nature or magnitude of risks has changed.
5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or his/her designee, a public hearing will be held. The Executive Director will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Executive Director will take one of the following actions:

1. Adopt the proposed amendment as presented.
2. Adopt the proposed amendment with modifications.
3. Defer the amendment request for further consideration and/or hearing.
4. Reject the amendment request.

### **Implementation through Existing Programs**

Once this plan is promulgated participating cities and counties will be able to include the valuable information in this plan into existing programs and plans. These can include the General or Master Plan, Capital Improvements Plan, Emergency Operations Plan, State Mitigation Plan, City Mitigation Plans.

Many of the mitigation actions developed by the cities and counties have elements of mitigation implementation including the NFIP, Fire Code, BCEGS, and CRS all of which have been implemented.

#### Process

It will be the responsibility of Mayor/Council/Commissioner(s) of each jurisdiction, as he/she/they see fit, to ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

#### Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The WFRC jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the plan identifies the primary Federal and State grant programs for WFRC jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

#### **Federal Programs**

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program

Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for “small and impoverished communities”, who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local Natural Hazard Pre-Disaster Mitigation Planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program

Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal

share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program  
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406  
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: SBA Disaster Assistance Program  
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants  
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants for post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

## **State Programs**

### Local

Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

### Non-Governmental

Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this plan.

## **Continued Public Involvement**

Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. The plan will be available on the WFRC and Utah DESHS website's to provide opportunities for public participation and comment. The plan will also be available for review at the offices of the Wasatch Front Regional Council.

The Wasatch Front Regional Council has been designated as the lead agency in preparing and submitting the Wasatch Front Regional Council Natural Hazard Pre-Disaster Mitigation Plan, which includes coverage for all incorporated cities and counties within the five county region, i.e. Davis, Morgan, Salt Lake, Tooele,

and Weber Counties. The strategy of the Association of Governments in preparing the plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the AOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. The AOG will publicly advertise all hearings, requests for input and meetings directly related to the Natural Hazard Pre-Disaster Mitigation Planning process. Meetings of the Wasatch Front Regional Council where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings, as they are public and open to all. Advertisement will be done according to the pattern set in previous years, i.e. the AOG will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the Salt Lake Tribune and/or Deseret News. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The AOG has established a mailing list of many local agencies and individuals that may have an interest in the Natural Hazard Pre-Disaster Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the plan; however, the AOG reserves the right to limit comments that are excessively long due to the size of the plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the AOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Natural Hazard Pre-Disaster Mitigation Plan will be presented to the WFRC Executive Director for adoption and approval to submit the document to State authorities. WFRC policies on adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the plan, the plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide AOG staff in making access and input to the Natural Hazard Pre-Disaster Mitigation Plan as open and convenient as possible:

A. Participation:

All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The AOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings:

Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information:

Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Natural Hazard Pre-Disaster Mitigation Plan, and/or any other documents prepared for distribution by the AOGs that may be adopted as part of the plan by reference. The AOG may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance:

Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. AOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The AOG will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings:

The AOG will plan and hold public hearings according to the following priorities:

1. Hearings will be conveniently timed for people who might benefit most from mitigation programs.
2. Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy).
3. Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including to: Identify and profile hazards, Develop mitigation strategies, and Review plan goals, performance, and future plans.

F. Future Revisions:

Future revisions of the plan shall include:

1. Expanded vulnerability assessments to include flood and dam failure inundation.
2. Continue the search for more specific mitigation actions.
3. An analysis of progress of the plan as it is revised.
4. Expanded look into how the identified natural hazards will affect certain populations including the young and elderly.